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UPPER CRETACEOUS FORAMINIFERA FROM TRINIDAD

BY

JOSEPH A. CUSHMAN AND P. W. JARVIS

Cushman Laboratory for Foraminiferal Research, Sharon, Mass.

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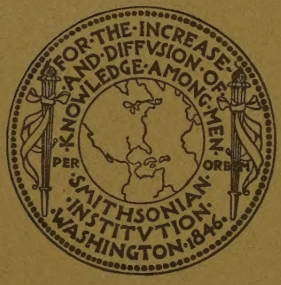

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UPPER CRETACEOUS FORAMINIFERA FROM TRINIDAD

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INTRODUCTION

Cretaceous foraminifera have already been described from Trinidad,[1] but further collecting and continued study of Trinidad material have increased considerably the fauna already described in this previous paper. Though the arenaceous forms are often badly distorted, on account of pressure and conditions of fossilization, the calcareous forms are usually well preserved and show much of their original detail. The entire collection represents a rather deep-water fauna that is not common in the Upper Cretaceous deposits of the general Gulf Coastal Plain of the United States, although the Velasco shale of the Tampico region represents most nearly the conditions under which these Cretaceous deposits of Trinidad were laid down. The Trinidad material, however, is very much better preserved than that of most of the Velasco shale, and it is therefore much better for detailed studies.

Many of the genera and also many of the species of the arenaceous group that are still living in the deeper waters off the coast of Trinidad are to be found in this Cretaceous material, often in considerable numbers. Such genera as *Glomospira*, *Ammodiscus*, *Ammodiscoides*, *Ammolagena*, *Hormosina*, *Saccorhiza*, and others are common in the Trinidad collections. All these genera are known living off Trinidad and usually in the same species, so that they seem to indicate that conditions of deposition for this material in the Upper Cretaceous are not very different from those that obtain off these coasts at the present day.

As already known from studies of the general Upper Cretaceous of the Gulf Coastal Plain of the United States, most of the species found are already described by various European workers from

[1] Cushman and Jarvis, Cretaceous foraminifera from Trinidad. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 85–103, pls. 12–14, December, 1928.

Cretaceous deposits of similar age from Europe and elsewhere. Since d'Orbigny's work in 1840, such authors as von Hagenow, Geinitz, Reuss, Alth, Schwager, Egger, Beissel, Franke, and others have described many species from the European Upper Cretaceous. This literature has been carefully studied, together with abundant material from the Upper Cretaceous of Ireland, England, France, Holland, and Germany, and the striking resemblance of American deposits to those of Europe has been constantly emphasized. As a result very few new forms have had to be described from this Trinidad material. Occasional striking forms seem to be new, but they are the exception.

The Upper Cretaceous, especially of the Gulf Coastal Plain of the United States, is of great economic importance to the petroleum industry in geologic correlation. The entire region of the Gulf of Mexico and the Caribbean Sea was during Upper Cretaceous times an area of general deposition of the Upper Cretaceous. Though this Trinidad material is from deeper water than most of the Gulf Coastal Plain deposits, nevertheless it contains many species in common with those deposits, and this paper should therefore be useful in connection with studies now being pursued of the various Cretaceous regions of the Western Hemisphere.

The plates are from drawings of Trinidad specimens by Miss Margaret S. Moore.

In order that available literature of recent years on the Cretaceous of America may be available to students, a list of these publications is given here. Many references to these will be found in the synonymy under the various species.

Even a slight examination of the European and other literature will show that later authors have diverged widely from the original description and figures given by the earlier authors who described many of the Cretaceous species. As a result it has been felt wise in many cases to give only the first reference to a species. The following papers will be of use to anyone working with American Cretaceous material:

A BIBLIOGRAPHY OF PAPERS ON THE FORAMINIFERA (EXCLUSIVE OF ORBITOIDIDAE) FROM THE AMERICAN UPPER CRETACEOUS

BAGG, R. M.
1898. The Cretaceous foraminifera of New Jersey. U. S. Geol. Surv. Bull. 88, pp. 1–89, pls. 1–6.

CARMAN, KATHERINE.
1929. Some foraminifera from the Niobrara and Benton formations of Wyoming. Journ. Pal., vol. 3, pp. 309–315, pl. 34.

CARSEY, D. O.
1926. Foraminifera of the Cretaceous of central Texas. Univ. Texas Bull. 2612, pp. 1–56, pls. 1–8.

CHURCH, C. C.

1929. The occurrence of *Kyphopyxa* in California. Journ. Pal., vol. 3, p. 411.

CUSHMAN, J. A.

1926. The foraminifera of the Velasco shale of the Tampico Embayment. Bull. Amer. Assoc. Petr. Geol., vol. 10, pp. 581–612, pls. 15–21.

1926. Some foraminifera from the Mendez shale of eastern Mexico. Contr. Cushman Lab. Foram. Res., vol. 2, pp. 16–26, pls. 2, 3.

1927. Some characteristic Mexican fossil foraminifera. Journ. Pal., vol. 1, pp. 147–172, pls. 23–28.

1927. Some foraminifera from the Cretaceous of Canada. Trans. Roy. Soc. Canada, sect. 4, pp. 127–132, pl. 1.

1927. American Upper Cretaceous species of *Bolivina* and related species. Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, pp. 85–91, pls. 11, 12.

1927. New and interesting foraminifera from Mexico and Texas. Contr. Cushman Lab. Foram. Res., vol. 3, pp. 111–117, pls. 22, 23.

1927. Foraminifera of the genus *Siphonina* and related genera. Proc. U. S. Nat. Mus., vol. 72, art. 20, pp. 1–15, pls. 1–4. (One Upper Cretaceous species included.)

1928. The American Cretaceous foraminifera figured by Ehrenberg. Journ. Pal., vol. 1, no. 3, pp. 213–217, pls. 34–36, Jan.

1928. A Cretaceous *Cyclammina* from California. Contr. Cushman Lab. Foram. Res., vol. 4, p. 70, pl. 9, figs. 5*a*, *b*.

1928. A peculiar *Clavulina* from the Upper Cretaceous of Texas. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 61, 62, pl. 8, figs. 1, 2.

1928. Fistulose species of *Gaudryina* and *Heterostomella*. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 107–112, pl. 16. (Includes Cretaceous species.)

1929. *Kyphopyxa*, a new genus from the Cretaceous of Texas. Contr. Cushman Lab. Foram. Res., vol. 5, pp. 1–4, pl. 1, figs. 1–7.

1929. Some species of *Siphogenerinoides* from the Cretaceous of Venezuela. Contr. Cushman Lab. Foram. Res., vol. 5, pp. 55–59, pl. 9, figs. 5, 6, 11–15.

1930. Notes on Upper Cretaceous species of *Vaginulina*, *Flabellina*, and *Frondicularia* from Texas and Arkansas. Contr. Cushman Lab. Foram. Res., vol. 6, pp. 25–38, pls. 4, 5.

CUSHMAN, J. A., and CHURCH, C. C.

1929. Some Upper Cretaceous foraminifera from near Coalinga, California. Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, pp. 497–530, pls. 36–41.

CUSHMAN, J. A., and HARRIS, REGINALD W.

1927. Some notes on the genus *Ceratobulimina*. Contr. Cushman Lab. Foram. Res., vol. 3, pp. 171–179, pls. 29, 30. (One species from the Navarro of Texas included.)

CUSHMAN, J. A., and HEDBERG, HOLLIS D.

1930. Notes on some foraminifera from Venezuela and Colombia. Contr. Cushman Lab. Foram. Res., vol. 6, pp. 64–69, pl. 9, figs. 1–13.

CUSHMAN, J. A., and JARVIS, P. W.

1928. Cretaceous foraminifera from Trinidad. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 85–103, pls. 12–14.

CUSHMAN, J. A., and OZAWA, YOSHIAKI.
1930. A monograph of the foraminiferal family Polymorphinidae, Recent and Fossil. Proc. U. S. Nat. Mus., vol. 77, art. 6, pp. 1–185, figs. 1, 2 (in text), pls. 1–40. (Contains numerous Cretaceous species.)

CUSHMAN, J. A., and WATERS, J. A.
1927. Some arenaceous foraminifera from the Upper Cretaceous of Texas. Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, pp. 81–85, pl. 10.
1929. Some Arenaceous foraminifera from the Taylor Marl of Texas. Contr. Cushman Lab. Foram. Res., vol. 5, pp. 63–66, pl. 10, figs. 3–7.

CUSHMAN, J. A., and WICKENDEN, R. T. D.
1928. A new foraminiferal genus from the Upper Cretaceous. Contr. Cushman Lab. Foram. Res., vol. 4, pp. 12, 13, pl. 1, figs. 1, 2.
1930. The development of *Hantkenina* in the Cretaceous with a description of a new species. Contr. Cushman Lab. Foram. Res., vol. 6, pp. 39–43, pl. 6, figs. 1–6.

JARVIS, P. W.
1929. Some notes on Cretaceous occurrences at Lizard Springs, Trinidad. Journ. Inst. Petr. Tech., vol. 15, pp. 440–442.

MOREMAN, W. L.
1927. Fossil zones of the Eagle Ford of north Texas. Journ. Pal., vol. 1, pp. 89–101, pls. 13–16 [pp. 98–100, pl. 16].

MORRISON, T. E.
1929. First authentic Cretaceous formation found on Gulf coast Salt Domes of Texas. Bull. Amer. Assoc. Petr. Geol., vol. 13, pp. 1065–1069.

REUSS, A. E.
1861. Paläontologische Beiträge. 4, Die Foraminiferen des senonischen Grünsandes von New Jersey. Sitz. Akad. Wiss. Wien, vol. 44, pp. 334–340.

TYRRELL, J. B.
1890. Foraminifera and Radiolaria from the Cretaceous of Manitoba. Trans. Roy. Soc. Canada, vol. 8, sect. 4, pp. 111–115.

WELLER, S.
1907. A report on the Cretaceous paleontology of New Jersey. Geological survey of New Jersey—Paleontology. Vol. 4, pp. 189–265, pls. 1–4.

WHITE, MAYNARD P.
1928–29. Some index foraminifera of the Tampico Embayment area of Mexico. Journ. Pal., vol. 2, pp. 177–215, pls. 27–29; pp. 280–317, pls. 38–42; vol. 3, pp. 30–58, pls. 4, 5.

Family ASTRORHIZIDAE

Genus RHABDAMMINA M. Sars, 1869

RHABDAMMINA DISCRETA H. B. Brady

PLATE 1, FIGURES 1, 2

In our material we have abundant broken specimens similar to those here figured. They have been referred to Brady's species, which they very closely resemble. The surface is roughened, but none of them shows any central chamber. It is worthy of note here that Franke in his work on the Cretaceous of Germany described a species as *Astrorhiza cretacea* Franke. It may be possible that our

fragmentary specimens represent the arms of some such form, but until complete specimens are obtained it may be left under *Rhabdammina*.

Family SACCAMMINIDAE

Subfamily SACCAMMININAE

Genus SACCAMMINA M. Sars, 1869

SACCAMMINA RHUMBLERI (Franke) (?)

PLATE 1, FIGURE 3

There are smooth specimens of a globular shape such as are figured here, the position of which is more or less questionable. In their general characters they resemble specimens that Franke has referred to as "*Orbulinaria rhumbleri*." These specimens of ours seem to belong to the genus *Saccammina*, but otherwise they are very close to the German ones.

Subfamily PELOSININAE

Genus PELOSINA H. B. Brady, 1879

PELOSINA COMPLANATA Franke

PLATE 1, FIGURES 4–6

Pelosina complanata FRANKE, Jahrb. kön. Preuss. Geol. Landes., vol. 32, pt. 2, p. 107, pl. 3, figs. 1*a*, *b*, 1911; Abh. Preuss. Geol. Landes., vol. 111, p. 10, pl. 1, fig. 6, 1928.

Saccammina scruposum WHITE (not *Haplophragmium scruposum* Berthelin), Journ. Pal., vol. 2, p. 183, pl. 27, fig. 5, 1928.

Test free, single, invariably crushed to a lenticular shape; wall replaced by amorphous silica, rough; aperture single, round, with short neck.

There are abundant specimens, especially in the Hobson clay from the Cretaceous of Trinidad, similar to those figured. They vary considerably in the coarseness of the material of the test, but this character is a common one in the general arenaceous group. Specimens have a definite protuberant neck with a circular aperture. The specimens are always collapsed, and the center is usually occupied by a depressed area. They seem to be identical with the specimens described and figured by Franke under the above name. They are apparently identical with the specimens referred to by White under the above reference. There is a possibility that these represent the megalospheric form of the species referred to further on in this paper as *Hormosina globulifera*. In Recent material of that species megalospheric forms are often found with a single large chamber and usually in considerable abundance. These specimens, therefore, are placed here with considerable doubt as to their true position.

Family HYPERAMMINIDAE

Subfamily HYPERAMMININAE

Genus HYPERAMMINA H. B. Brady, 1878

HYPERAMMINA ELONGATA H. B. Brady

PLATE 1, FIGURES 7, 8

Hyperammina elongata H. B. BRADY, Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 433, pl. 20, figs. 2*a*, *b*, 1878.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, fig. 1, 1928.

There are in the Cretaceous material from Trinidad a number of specimens evidently belonging to *Hyperammina* that have been already recorded in the above reference as *Hyperammina elongata* H. B. Brady. There is considerable variation in the relative quantity of cement used in the test, and consequently some of these are smoothly finished and others in which the quantity of arenaceous material is large are roughened. Similar conditions are found in Recent material. Franke notes the occurrence of a *Hyperammina* in the German Cretaceous, but does not give a definite name to his material.

HYPERAMMINA (?) sp. (?)

PLATE 1, FIGURE 9

There are a number of specimens in our material similar to that here figured, which, as one end is closed and the other open, seem to belong to this genus. All these, however, have a distinctly collapsed appearance and are more or less distorted, and so there may be some question as to the true generic position. They are given here for future reference for other workers on the group.

Subfamily DENDROPHRYINAE

Genus SACCORHIZA Eimer and Fickert, 1899

SACCORHIZA RAMOSA (H. B. Brady)

PLATE 1, FIGURES 10–12

Hyperammina ramosa H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 33, pl. 3, figs. 14, 15, 1879; Denkschr. Akad. Wiss. Wien, vol. 42, p. 98, 1881; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 261, pl. 23, figs. 15–19, 1884.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, no. 7, p. 217, pl. 41, figs. 1–4, 13, 1888.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, p. 255, pl. 4, fig. 15, 1893.—GOËS, Köngl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, p. 18, pl. 4, figs. 61, 62, 1894; Bull. Mus. Comp. Zoöl., vol. 29, p. 22, 1896.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 13; Biological results fishing experiments *Endeavour* 1909–14, vol. 3, pt. 1, p. 13, 1915.—FLINT, Rep. U. S. Nat. Mus. for 1897, p. 270, pl. 11, fig. 1, 1899.—RHUMBLER,

Arch. Prot., vol. 3, p. 260, figs. 101 *a*, *b* (in text), 1903.—HERON-ALLEN and EARLAND, Trans. Linn. Soc. London, vol. 11, pt. 13, p. 220, 1916.

Saccorhiza ramosa EIMER and FICKERT, Zeitschr. Wiss. Zool., vol. 65, p. 670, 1899.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 65, fig. 81 (in text), 1910; U. S. Nat. Mus. Bull. 104, pt. 1, p. 81, pl. 30, figs. 3, 4, 1918.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, p. 1004, 1914.

There are numerous fragmentary specimens in the Cretaceous from Trinidad that may be referred to the above species with little question. The tubes are somewhat collapsed, but they have the characteristic irregular curvature and especially the roughened surface often carrying broken spicules. No branching specimens were found. Franke [2] has recorded very similar, branching fragments from the German Cretaceous as "*Rhizammina algaeformis.*" White [3] records a tubular fragment from the Velasco shale of Mexico as "*Rhizammina indivisa.*"

Family REOPHACIDAE

Subfamily REOPHACINAE

Genus REOPHAX Montfort, 1808

REOPHAX sp. (?)

PLATE 1, FIGURE 13

Reophax sp. (?) CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, fig. 2, 1928.

No further specimens were found of the form figured here, which is the same one figured in the above reference.

Genus HORMOSINA H. B. Brady, 1879

HORMOSINA GLOBULIFERA H. B. Brady

PLATE 1, FIGURE 14

Hormosina globulifera H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 60, pl. 4, figs. 4, 5, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 326, pl. 34, figs. 1–6, 1884.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, fig. 3, 1928.

Specimens of this species are usually collapsed to some extent, especially the later chambers, like those in the specimen here figured. The Cretaceous specimens seem to be exactly identical with the Recent ones that occur in Atlantic waters. As already noted under *Pelosina complanata*, there is a distinct possibility that those specimens may represent the megalospheric stage of *Hormosina globulifera*. This is one of the species that give the close relationship of

[2] Abh. Preuss. Geol. Landes., vol. 111, p. 12, pl. 1, fig. 13, 1928.
[3] Journ. Pal., vol. 2, p. 184, pl. 7, fig. 2, 1928.

this Cretaceous material to the Recent deep-water fauna of the Atlantic.

Genus NODELLUM Rhumbler, 1913

NODELLUM VELASCOENSIS (Cushman)

PLATE 1, FIGURES 15–17

Nodosinella velascoensis CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 583, pl. 20, fig. 9, 1926.—WHITE, Journ. Pal., vol. 2, p. 309, pl. 41, fig. 15, 1928.

This species has already been recorded from the Velasco shale of Mexico, where it occurs in some abundance. It is very abundant, however, in the Hobson clay of Trinidad. Though it is usually distorted, as in Mexico, specimens are so abundant that a certain proportion of them may be found that shows the normal form of the species. The proloculum is always longer than broad and somewhat pear-shaped. The following chambers in the megalospheric form increase very little if at all in diameter, while in the microspheric form they are much more numerous and increase rapidly in size as added. The wall seems to be almost entirely chitinous and nearly transparent, a fact that accounts for specimens being usually very much distorted. The other specimens of this genus are characteristic of comparatively deep water of the present oceans.

Family AMMODISCIDAE

Subfamily AMMODISCINAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS GLABRATUS Cushman and Jarvis

PLATE 2, FIGURE 1

Ammodiscus glabratus CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 86, pl. 12, figs. 6 *a*, *b*, 1928.

Test planispiral, much compressed, concave on both sides, periphery broadly curved; tubular chamber very gradually and uniformly increasing in size with succeeding coils; wall thin, composed almost entirely of cement, of a brownish color, very smooth and polished; aperture semicircular, at the end of the tubular chamber.

This species was originally described from the Lizard Springs material, and also occurs in the later collections from the Hobson clay of San Fernando. The material of the test is almost entirely pure cement, although with a considerable magnification fragmentary material of small size can be seen.

AMMODISCUS PENNYI Cushman and Jarvis

PLATE 2, FIGURES 2, 3

Ammodiscus pennyi CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 87, pl. 12, figs. 4, 5, 1928.

Test planispiral, comparatively large, periphery broadly rounded, of a few coils, the tubular chamber increasing gradually in diameter; suture deep and distinct; wall thick, conspicuously arenaceous but fairly smoothly finished; aperture semicircular at the end of the tube.

This is one of the largest species of the genus and is represented by both megalospheric and microspheric specimens. In contrast with the preceding species, the wall is very thick and has much arenaceous material. It occurs in the pit at Lizard Springs, as well as at a depth of 720 feet.

Genus AMMODISCOIDES Cushman, 1909

AMMODISCOIDES TURBINATUS Cushman

PLATE 2, FIGURES 4, 5

Ammodiscoides turbinatus CUSHMAN, Proc. U. S. Nat. Mus., vol. 36, p. 424, pl. 33, figs. 1–6, 1909; U. S. Nat. Mus. Bull. 104, pt. 1, p. 98, pl. 36, figs. 3–6, pl. 37, 1918.—RHUMBLER, Foraminifera of the Plankton-Expedition, pt. 2, p. 388, figs. 124 *a*, *d* (in text), 1913.

The Cretaceous material referred to this species has been very carefully compared with the types in Recent dredgings, and there are no characters by which they may be separated. Except for the differences due to fossilization, it would be impossible to tell the fossil and Recent specimens apart if they were mixed. This seems to be an excellent example of the persistence of a species over a long period where unchanged ecologic conditions have prevailed.

The early whorls form a low cone on one side, and on the opposite side a distinct depression, after which the succeeding coils are practically in a single plane. The genus is already known from the Paleozoic and Recent collections, and this Cretaceous one is interesting as partially filling the gap between these. This species was originally described from dredgings in the Gulf of Mexico, so that it has persisted under similar conditions since the Cretaceous at least.

Genus GLOMOSPIRA Rzehak, 1888

GLOMOSPIRA GORDIALIS (Jones and Parker)

PLATE 2, FIGURES 6, 7

Trochammina squamata var. *gordialis* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, p. 304, 1860.—PARKER and JONES, Philos. Trans., vol. 155, p. 408, pl. 15, fig. 32, 1865.

Glomospira gordialis CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 1, p. 99, pl. 36, figs. 7–9, 1918.—WHITE, Journ. Pal., vol. 2, p. 187, pl. 27, fig. 8, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 87, pl. 12, figs. 7, 8, 1928.

As is usual in Recent material this species shows a very considerable variation in the shape of the test, which is typically compressed in distinction from the following one, which is more or less globular in shape. Specimens appear to be identical with Recent material from this same general region in comparatively deep water.

GLOMOSPIRA CHAROIDES (Jones and Parker) var. CORONA Cushman and Jarvis

PLATE 2, FIGURES 8–10

Glomospira charoides (JONES and PARKER) var. *corona* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 89, pl. 12, figs. 9–11, 1928.

Glomospira charoides (JONES and PARKER), WHITE, Journ. Pal., vol. 2, p. 187, pl. 27, fig. 8, 1928.

Variety differing from the typical in having the irregularly coiled later portion in a sort of irregular crown at the end of the test instead of coiling about the whole test as in the typical form.

This variety also occurs in the Cretaceous, Velasco shale of Mexico from which we have specimens. It is the form figured by White [4] from the Velasco. Recent specimens that we have seen, as well as those figured, have the later portion coiling in the long axis of the test after the spiral is completed.

Genus LITUOTUBA Rhumbler, 1895

LITUOTUBA LITUIFORMIS (H. B. Brady)

PLATE 2, FIGURES 11 *a*, *b*

Trochammina lituiformis H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 59, pl. 5, fig. 16, 1879.

Lituotuba lituiformis RHUMBLER, Nachr. Köngl. Ges. Wiss. Göttingen, p. 84, 1895; Arch. Prot., vol. 3, p. 279, figs. 128, *a*, *b*, 1903.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 114, fig. 175 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 90, pl. 12, figs. 15 *a*, *b*, 1928.

The figured specimen is evidently megalospheric and may be a distinct species, but the microspheric form should be studied. The uncoiled portion is partially collapsed.

No further specimens of this species have been found in a further search of the Trinidad Cretaceous. It has been left under Brady's species for the present at least. Franke, however, has described a somewhat similar species as "*Lituotuba incertus*" from the Upper Cretaceous of Germany. Further specimens may show that Cretaceous specimens of Germany and America are identical and distinct from the Recent one.

[4] Journ. Pal., vol. 2, pl. 27, fig. 7, 1928.

Subfamily TOLYPAMMININAE

Genus AMMOLAGENA Eimer and Fickert, 1899

AMMOLAGENA CLAVATA (Jones and Parker)

PLATE 2, FIGURE 12

Trochammina irregularis var. *clavata* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, p. 304, 1860.

Webbina clavata H. B. BRADY, Proc. Roy. Soc. Edinburgh, vol. 11, p. 711, 1882; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 349, pl. 41, figs. 12–16, 1884.

Ammolagena clavata EIMER and FICKERT, Zeitschr. Wiss. Zool., vol. 65, p. 673, 1899.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 68, figs. 86–89 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 90, pl. 12, fig. 14, 1928.

A single specimen of the megalospheric form is shown in the accompanying figure. There are other specimens that evidently are microspheric, in which the proloculum is much smaller and the tube much longer, as in Recent specimens. There seems to be no difference between these Cretaceous forms and Recent forms from the same general area. Specimens were found attached to *Ammodiscus pennyi*, *Glomospira gordialis*, and *Hyperammina elongata*. These show that the same general relationship of these genera was already definitely present in the Upper Cretaceous. In the present oceans *Ammolagena clavata* is often found attached to these genera and others of the arenaceous group, as well as to some of the flattened calcareous forms. This is another of the species that has kept its identity and its characters at least since Cretaceous times without any distinct change that is apparent.

Family LITUOLIDAE

Subfamily HAPLOPHRAGMIINAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES CORONATA (H. B. Brady)

PLATE 2, FIGURES 13–15

Trochammina coronata H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 58, pl. 5, fig. 15, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 340, pl. 40, figs. 10–12, 1884.

Haplophragmoides coronata CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 99, figs. 145–147 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 90, pl. 12, fig. 17, 1928.

Trochamminoides irregularis WHITE, Journ. Pal., vol. 2, p. 307, pl. 42, fig. 1, 1928.

Trochamminoides proteus WHITE (not Karrer), vol. 2, p. 308, pl. 42, fig. 2, 1928.

The Cretaceous specimens, while most of them are distorted and collapsed, have the general characters of the Recent species that occurs often abundantly in the present ocean in this same general region. Often the color of the Recent and Cretaceous forms is very similar. It is somewhat difficult to distinguish this species from

Trochammina globigeriniformis, noted later, on account of the distortion that takes place in fossilization, resulting in some very queer-shaped specimens. The specimens described by White in the above references are probably distorted forms of this species. His *Trochamminoides irregularis* is probably the megalospheric form, and *T. proteus* the microspheric form. These may, however, be much distorted forms of *T. globigeriniformis*, and without seeing the original specimens it is difficult for one to determine this, even if it might then be possible. The distortion produced is often so great as very largely to obliterate the original form.

HAPLOPHRAGMOIDES EXCAVATA Cushman and Waters

PLATE 3, FIGURE 1

Haplophragmoides excavata CUSHMAN and WATERS, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, p. 82, pl. 10, figs. 3 *a*, *b*, 1927.—CUSHMAN, Trans. Roy. Soc. Canada, sec. 4, p. 128, pl. 1, fig. 1, 1927.

Haplophragmoides sp. (?) CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 12, fig. 16, 1928.

This species was originally described from the Upper Cretaceous, Navarro formation of Hunt County, Tex., where it is a common species. It has also been recorded from the Upper Cretaceous of western Canada in the above reference. Its distribution is very wide, and it is one of those species that persist in leached material where many of the calcareous forms have disappeared.

HAPLOPHRAGMOIDES EGGERI Cushman

PLATE 3, FIGURES 2 *a*, *b*

Haplophragmium fontinense EGGER (not Terquem), Ber. nat. Regensburg, vol. 12, 1907–1909, p. 10, pl. 3, figs. 16–18, 1910.

Haplophragmoides eggeri CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 583, pl. 15, figs. 1 *a*, *b*, 1926.

Haplophragmoides cf. *subglobosum* (G. O. SARS), CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 12, figs. 13 *a*, *b*, 1928.

This species, described previously from the Velasco shale of Mexico, occurs in Europe, Mexico, and Trinidad, and probably elsewhere. It is somewhat variable and on account of distortion assumes various shapes.

Genus CRIBROSTOMOIDES Cushman, 1910

CRIBROSTOMOIDES TRINITATENSIS Cushman and Jarvis

PLATE 3, FIGURE 3

Cribrostomoides trinitatensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 12, figs. 12 *a*, *b*, 1928.

This genus has apparently not been recorded elsewhere in the Cretaceous. It is a somewhat broader, more globular form than the

Recent species and is fairly abundant in the material from Lizard Springs, but it was not found in the other collections.

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES COPROLITHIFORME (Schwager)

PLATE 3, FIGURES 4, 5

Haplophragmium coprolithiforme SCHWAGER, *in* Benecke's Geogn.-pal. Beiträge, vol. 1, p. 654, pl. 34, fig. 3, 1868.

Ammobaculites coprolithiforme CUSHMAN, Trans. Roy. Soc. Canada, sec. 4, p. 130, pl. 1, figs. 6, 7, 1927.

Test elongate, early portion close coiled, later chambers rectilinear, of uniform width, generally circular in section; sutures distinct, depressed; wall arenaceous but smoothly finished; aperture circular, terminal.

This species originally described from the Cretaceous of Europe has already been recorded from the Upper Cretaceous of western Canada. Identical specimens occur in the Cretaceous of Trinidad, and the striking similarity of these may be seen by comparison of the figures of the specimens of the two regions. It is quite probable that some of the European specimens referred to *Ammobaculites agglutinans* may belong to Schwager's species. The figures seem to be similar.

Subfamily LITUOLINAE

Genus CYCLAMMINA H. B. Brady, 1876

CYCLAMMINA ELEGANS, new species

PLATE 3, FIGURES 6 *a*, *b*

Description.—Test comparatively large, close coiled, periphery somewhat lobulated and subacute, or at least compressed; chambers numerous, usually 10 to 12 in the last-formed coil; sutures distinct, slightly depressed, usually sigmoid; wall smooth, distinctly arenaceous, thin, with a very even cancellated structure of the interior showing through; aperture consisting of a low curved arch at the base of the apertural face with numerous supplementary rounded openings scattered over the central portion of the apertural face, often with slightly raised borders. Length, 2; breadth, 1.25; thickness, 0.85 mm.

Holotype.—U.S.N.M. No. 73815 (Cushman Coll. No. 15280), from Upper Cretaceous, from pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is fairly common in the Lizard Springs Cretaceous, and is especially marked by the thin outer wall and the distinct

markings of the cancellated interior, which show distinctly from the outside.

Family TEXTULARIIDAE

Subfamily SPIROPLECTAMMININAE

Genus SPIROPLECTAMMINA Cushman, 1927

SPIROPLECTAMMINA DENTATA (Alth)

PLATE 3, FIGURES 7 *a*, *b*

Textularia dentata ALTH, Haidinger's Naturw. Abh., vol. 3, p. 262, pl. 13, fig. 13, 1850.

The figured specimen shows fairly well the characters of this species described by Alth from the Upper Cretaceous of Europe. The chambers are low and broad, with the outer margins often ending in a distinct point. In some respects this species is closely allied to *S. anceps* (Reuss).

SPIROPLECTAMMINA ANCEPS (Reuss) var.

PLATE 3, FIGURES 8 *a*, *b*

In the Trinidad Cretaceous, specimens occur that are clearly and closely allied to Reuss's species. Two forms occur, one in which the sutures are distinct but not depressed or raised, and the other, figured herein, in which the sutures themselves are slightly thickened. They somewhat resemble such forms as *Textularia mexicana* Cushman, known from the Tertiary of this general region and now living in the Gulf of Mexico, and also the form described by W. Berry as *Textularia ripleyensis*. This Trinidad form differs from either of these, but material was not sufficient to warrant its being described as a distinct variety. In some respects it resembles the form described as "*Bolivina velascoensis*" from the Upper Cretaceous, Velasco shale of Mexico.[5]

SPIROPLECTAMMINA EXCOLATA (Cushman)

PLATE 3, FIGURES 9, 10

Textularia excolata CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 585, pl. 15, figs. 9 *a*, *b*, 1926.—WHITE, Journ. Pal., vol. 3, p. 30. pl. 4, figs. 1 *a*, *b*, 1929.

Test as broad as long, the sides flattened or somewhat convex; periphery, of early portion at least, acute; chambers few, the sides somewhat concave; sutures distinct on account of the thickening of the peripheral edge, the surface below being somewhat concave; wall smoothly finished.

[5] Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 586, pl. 16, figs. 1 *a*, *b*, 1926.

This species, originally described from the Velasco shale of Mexico and later recorded by White from the same formation, occurs in the Upper Cretaceous of Trinidad, where it is fairly common in the material from Lizard Springs. A rather typical specimen is figured (pl. 3, fig. 9), as well as an extreme form (pl. 3, fig. 10), in which the excavations of the chambers are carried to an unusual degree. This particular specimen also shows the spiral early chambers to good advantage.

Subfamily TEXTULARIINAE

Genus TEXTULARIA Defrance, 1824

TEXTULARIA CONCINNA Reuss

PLATE 4, FIGURES 1, 2

Textularia concinna REUSS, Verstein. Böhm. Kreide, pt. 2, p. 109, pl. 24, fig. 54, 1845–46.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 91, pl. 13, fig. 1, 1928.

Two forms occur in the Cretaceous of Trinidad that are here referred to Reuss's species. They occur together at the same locality, but one of these is much larger than the other. The angles of the chambers, however, are similar, and one may represent the microspheric and the other the megalospheric form of the same species. The smaller specimens are very typical of this species described by Reuss from Europe.

Family VERNEUILINIDAE

Genus VERNEUILINA d'Orbigny, 1840

VERNEUILINA POLYSTROPHA (Reuss)

PLATE 4, FIGURES 3 *a*, *b*

Bulimina polystropha REUSS, Verstein. Böhm. Kreide, pt. 2, p. 109, pl. 24, fig. 53, 1845–46.—ALTH, Haidinger's Naturw. Abh., vol. 3, pt. 2, p. 265, pl. 13, fig. 19, 1850.

Verneuilina polystropha H. B. BRADY, Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 436, pl. 20, figs. 9 *a–c* (?), 1878.

Test elongate, slightly tapering, triserial, rounded in end view; chambers inflated, distinct, slightly longer than broad; sutures distinct, depressed; wall arenaceous, rather smoothly finished; aperture rounded at the inner margin of the last-formed chamber. Length, 0.45; breadth, 0.15 mm.

This species was described by Reuss from the Cretaceous of Germany. It occurs in the Cretaceous of America, but the Recent material usually referred to it is probably not the same.

Genus TRITAXIA Reuss, 1860

TRITAXIA PYRAMIDATA Reuss

PLATE 4, FIGURES 4 *a*, *b*

Tritaxia pyramidata REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, pp. 32, 88, pl. 1, fig. 9, 1862 (1863); Palaeontographica, vol. 20, pt. 2, p. 123, 1872–75 (1874).—BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 25, pl. 1, figs. 4 *a–c*, 1880.—CHAPMAN, Journ. Roy. Micr. Soc., p. 2, pl. 11, figs. 2 *a*, *b*, 1892.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 18, pl. 2, figs. 1 *a–c*, 1925; Abh. Preuss. Geol. Landes., new ser., vol. 111, p. 138, pl. 12, figs. 18 *a–c*, 1928.

This is a common species in the European Cretaceous and occurs both in the Trinidad collections and also in those of the general Coastal Plain region of the United States. It differs from *Tritaxia tricarinata* in the much greater increase in diameter toward the apertural end, that of typical *T. tricarinata* being of generally uniform width throughout. The test is triserial throughout, and the aperture becomes rounded and terminal, usually protuberant, and with a slight lip.

Genus GAUDRYINA d'Orbigny, 1839

GAUDRYINA FILIFORMIS Berthelin

PLATE 4, FIGURE 5

Gaudryina filiformis BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 25, pl. 1 (24), figs. 8*a–d*, 1880.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 92, pl. 13, fig. 2, 1928.

In the Lizard Springs material, typical slender specimens of this species occur. The small, very elongate, slender test and the considerable length of the early triserial stage will distinguish it. It is widely distributed in the Cretaceous of various parts of the world.

GAUDRYINA RUGOSA d'Orbigny

PLATE 4, FIGURES 6 *a*, *b*

Gaudryina rugosa D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 44, pl. 4, figs. 20, 21, 1840.—REUSS, Verstein. Böhm. Kreide, pt. 1, p. 38, pl. 12, figs. 15, 24, 1845–46; *in* Geinitz, Grundr. Verstein., p. 667, pl. 24, fig. 69, 1845–46; Sitz. Akad. Wiss. Wien, vol. 18, p. 244, pl. 5, fig. 61, 1856.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 14, pl. 1, fig. 19, 1925; Abh. Preuss. Geol. Landes., new ser., vol. 111, p. 141, pl. 13, fig. 2, 1928.

Textularia agglutinans W. BERRY (not d'Orbigny), *in* Berry and Kelley, Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 3, pl. 2, fig. 1, 1929.

Test elongate, tapering, greatest breadth toward the apertural end, periphery broadly rounded, early triserial portion usually much reduced, but the change to the biserial stage very abrupt; chambers numerous, usually distinct in the biserial portion, indistinct in the triserial portion, very slightly inflated in the later development;

sutures becoming more distinct in the later portion, straight, very slightly oblique; wall rather coarsely arenaceous but usually fairly smoothly finished; aperture in the ordinary specimens, narrow, at the inner margin of the chamber with distinct lobular projections at the sides, in very long specimens the aperture tending to be somewhat higher. Length, 0.5–1 mm.

This is a very common species in the Cretaceous in Europe and America and probably in Australia. There is considerable variation in the microspheric and megalospheric forms, the former reaching a much greater size.

GAUDRYINA RETUSA Cushman

PLATE 4, FIGURES 7–10

Gaudryina retusa CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 588, pl. 16, figs. 10 *a*, *b*, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 92, pl. 13, figs. 3, 4, 1928.—WHITE, Journ. Pal., vol. 2, p. 313, pl. 42, figs. 8, 9, 1928.

Verneuilina sp. (?) CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 587, pl. 16, figs. 12*a*, *b*, 1926.

Verneuilina rotunda WHITE, Journ. Pal., vol. 2, p. 310, pl. 42, figs. 5 *a*, *b*, 1928.

Test fairly large, stout, nearly circular in transverse section, composed of few chambers, early ones triserial, later ones biserial; chambers distinct, somewhat inflated; sutures distinct, in the later portion slightly depressed; wall arenaceous but rather smoothly finished; aperture comparatively small, low.

White described a small form as *Verneuilina rotunda*. He also records *Gaudryina retusa* from the Upper Cretaceous of Mexico, and the range of his *V. rotunda* is included in his table in the range of *G. retusa*. It is very probable that the *Verneuilina* is only the young stage, perhaps of the microspheric form of *G. retusa*. The early triserial stages of *Gaudryina* and *Clavulina* have often been described as species of *Verneuilina* in the literature.

GAUDRYINA INDENTATA Cushman and Jarvis

PLATE 4, FIGURE 11

Gaudryina indentata CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 92, pl. 13, fig. 7, 1928.

Test somewhat elongate, tapering from the subacute initial end, the sides of the adult nearly parallel, circular in transverse section; chambers numerous, early ones triserial, adult biserial, the middle portion of each chamber indented and the sutures raised in rounded ridges; wall arenaceous but smoothly finished; aperture small, semicircular, at the base of the inner margin of the last-formed chamber. Length, 0.5; diameter, 0.4 mm.

This species is peculiar in having depressed chambers. The same form occurs in the Upper Cretaceous of the Velasco shale of Mexico.

GAUDRYINA OXYCONA Reuss

PLATE 5, FIGURES 1, 2

Gaudryina oxycona REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 229, pl. 12, figs. 3 *a–c*, 1860; vol. 46, p. 33, 1862 (1863).—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 15, pl. 1, figs. 20 *a*, *b*, 1925.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, p. 501, pl. 36, figs. 3, 4, 1929.

Test elongate, conical, tapering, nearly circular in transverse section; very early chambers triserial, later ones biserial; sutures distinct, slightly depressed, nearly at right angles with the periphery; wall finely arenaceous, very smoothly finished; aperture elongate, low, at the inner median margin of the chamber in a decided depression. Length, 0.55–1.25; breadth, 0.3–0.75 mm.

This is a widely distributed and well-characterized species. It is known from the California Cretaceous and occurs also in the Velasco shale of Mexico and in the Cretaceous of the Gulf Coastal region of the United States.

GAUDRYINA LAEVIGATA Franke var. PYRAMIDATA Cushman

PLATE 5, FIGURE 3

Gaudryina laevigata FRANKE var. *pyramidata* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 587, pl. 16, figs. 8*a*, *b*, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 92, pl. 13, fig. 6, 1928.—WHITE, Journ. Pal., vol. 2, p. 313, pl. 42, fig. 7, 1928.

Test differing from the typical in the stouter form, the early portion more pyramidal than the type; the periphery, instead of rounded and convex, slightly concave.

This variety is a common one in the Cretaceous of America and is already described from the Velasco shale of Mexico and from this Trinidad material. It occurs widely distributed in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Genus CLAVULINA d'Orbigny, 1826

CLAVULINA TRILATERA Cushman

PLATE 5, FIGURE 5

Clavulina trilatera CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 588, pl. 17, fig. 2, 1926; Journ. Pal., vol. 1, p. 149, pl. 28, fig. 1, 1927.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 93, pl. 13, fig. 8, 1928.

Test large, elongate, sides parallel for most of their length, slightly contracted at each end, entire test triangular in transverse section, the periphery rounded, the sides concave; chambers numerous, the early ones triserial, later ones forming the larger part of the test, uniserial; sutures very slightly if at all depressed, somewhat indistinct; wall coarsely arenaceous but very smoothly finished; aperture terminal, circular, with a very slight neck.

This species is apparently very abundant in the Gulf Coastal Cretaceous of the United States. The original figures show only the megalospheric form, which has nearly parallel sides and comparatively few chambers. The microspheric form is much larger and increases rapidly in diameter toward the apertural end, but usually occurs with the megalospheric form. The surface is usually smoothly finished, and quite different from the following species. It was originally described from the Upper Cretaceous, Velasco shale of Mexico and is common in the Cretaceous of Texas, Arkansas, and Tennessee but rare in this deeper-water material from Trinidad.

CLAVULINA ASPERA Cushman

PLATE 5, FIGURE 4

Clavulina trilatera CUSHMAN var. *aspera* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 589, pl. 17, fig. 3, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 93, pl. 13, fig. 5, 1928.—WHITE, Journ. Pal., vol. 2, p. 315, pl. 42, fig. 14, 1928.

This species was originally described as a variety of *Clavulina trilatera.* A further study of these forms from Mexico, Trinidad, and the general Gulf Coastal region of the United States seems to show that the two are distinct species. *C. aspera* always seems to have a rough surface, and in the typical form the sides are nearly parallel, although they may be somewhat more flaring in the microspheric form. Such specimens are rare in Trinidad, but the following variety is much more common.

CLAVULINA ASPERA Cushman WHITEI, new variety

PLATE 5, FIGURES 6–8

Clavulina trilatera WHITE (not Cushman), Journ. Pal., vol. 2, p. 315, pl. 42, fig. 13, 1928.

Description.—Differs from the typical in the shape of the test, which in the megalospheric form has the triangular portion confined to the early portion of the test after which a series of rounded chambers of nearly uniform size is developed, in the microspheric form, with the triangular form continued throughout or becoming quadrangular in section, test increasing gradually in diameter to the apertural end; wall roughened.

Holotype of variety.—U.S.N.M. No. 73816 (Cushman Coll. No. 15306), from Upper Cretaceous of pit at Lizard Springs, near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This variety is very common in the Trinidad material but is not well developed in the Upper Cretaceous of the United States, although it does occur in Mexico.

CLAVULINA CHITINOSA, new species

PLATE 5, FIGURES 9–11

Description.—Test elongate, slender, the early triserial portion often being of slightly greater diameter than the later uniserial portion; chambers numerous, fairly distinct; sutures distinct, depressed, especially in the last-formed part of the uniserial portion; wall almost entirely chitinous, clear, and translucent, very smooth; aperture terminal, with a slight neck and lip. Length, up to 1; diameter, up to 0.3 mm.

Holotype.—U.S.N.M. No. 73817 (Cushman Coll. No. 15315), from Upper Cretaceous of pit at Lizard Springs, near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a peculiar form evidently representing deep-water conditions, where the wall of the test becomes almost entirely pure chitin. As a result of this type of wall, specimens are usually much distorted, but the figures will give the general appearance of the species.

Family SILICINIDAE

Genus RZEHAKINA Cushman, 1927

RZEHAKINA EPIGONA (Rzehak) var. LATA Cushman and Jarvis

PLATE 6, FIGURES 1 *a*, *b*

Rzehakina epigona (RZEHAK) var. *lata* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 93, pl. 13, figs. 11 *a*, *b*, 1928.

Test differing from the typical in the broader, nearly circular form and the much more prominent appearance of the last coil, forming almost a rounded carina about the periphery. This is the commonest form in the collection. Some young specimens show the early coils making a flattened test before the lateral thickenings are added.

This variety is more rounded and much larger than the form found in the Velasco shale of Mexico. In addition to the Lizard Springs locality, it is abundant in the Hobson clay from San Fernando, Trinidad.

Family TROCHAMMINIDAE

Subfamily TROCHAMMININAE

Genus TROCHAMMINA Parker and Jones, 1860

TROCHAMMINA GLOBIGERINIFORMIS (Parker and Jones)

PLATE 6, FIGURES 2–5

Lituola globigeriniformis PARKER and JONES, Phil. Trans., vol. 155, p. 407, pl. 15, figs. 46, 47, pl. 17, figs. 96–98 ?, 1865.

Haplophragmium globigeriniforme CARPENTER, The microscope, ed. 6, p. 561, figs. 320 *a*, *b* (in text), 1881.

Trochammina globigeriniformis CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 124, figs. 193–195 (in text), 1910.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 95, pl. 13, figs. 12 *a*, *b*, 1928.

There are numerous excellent specimens of this species in the collection from Trinidad. Many specimens are crushed, but a number of them are in their original form like the figured one. These crushed forms are common both at Lizard Springs and in the Hobson clay from San Fernando, Trinidad. The remarks already made under *Haplophragmoides coronata* may be applicable to this species as well.

TROCHAMMINA TRINITATENSIS Cushman and Jarvis

PLATE 6, FIGURES 6 *a–c*

Trochammina trinitatensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 95, pl. 13, figs. 13 *a–c*, 1928.

Test nearly circular in dorsal view, biconvex from the periphery, trochoid, somewhat keeled, slightly umbilicate on the ventral side; chambers numerous, 12 or more in the final whorl, not very distinct except for the slight collapse of the wall; central portion of the dorsal side showing the spiral suture slightly depressed; the sutures of the ventral side nearly radial, slightly curved, depressed; wall arenaceous with numerous angular fragments and much cement; aperture elongate, ventral, at the base of the chamber. Diameter, 0.4; thickness, 0.2 mm.

This is a striking species, appearing at first glance something like an *Anomalina* but having an arenaceous test, which is easily collapsed.

Family LAGENIDAE

Subfamily NODOSARIINAE

Genus ROBULUS Montfort, 1808

There are numerous species of the Lagenidae in the Cretaceous of Trinidad, nearly all of which have already been described from the Cretaceous of Europe. An examination of the literature shows how

later authors have deviated from the type of the species until the later determinations show little relationship to the original. For this reason, in many cases, only the first reference is given in the synonymy.

ROBULUS WILLIAMSONI (Reuss)

PLATE 6, FIGURES 7 *a*, *b*

Cristellaria williamsoni REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 6, p. 327, pl. 6, figs. 4 *a*, *b*, 1861 (1862).—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, p. 503, pl. 36, figs. 13, 14, 1929.

The specimen figured here is very close to the typical form figured and described by Reuss from the Cretaceous of Germany. It has a distinct keel, few chambers, depressed and slightly curved sutures, and a smooth surface. The apertural face is distinctly concave with raised edges.

ROBULUS OLIGOSTEGIA (Reuss)

PLATE 6, FIGURES 8, 9

Cristellaria oligostegia REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 213, pl. 8, fig. 8, 1860; vol. 46, pt. 1, p. 93, pl. 13, figs. 2 *a*, *b*, 1862 (1863).

This is a very thick species with a few tumid chambers, the later ones showing a slight tendency to uncoil. The aperture is slightly protuberant.

ROBULUS STERNALIS (Berthelin)

PLATE 6, FIGURES 11 *a*, *b*

Cristellaria sternalis BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 51, pl. 3 (26), figs. 2 *a*, *b*, 1880.

This species may be distinguished from *R. williamsoni* by the distinctly umbonate character of the test. The angle of the sutures is very different in the two species, as are also the shape and form of the chambers.

ROBULUS TRINITATENSIS, new species

PLATE 6, FIGURES 10 *a*, *b*

Description.—Test close coiled, compressed, periphery slightly keeled; chambers fairly distinct, 6 to 8 in number in the adult, not inflated; sutures fairly distinct, strongly curved, continuing into the umbilical region, strongly limbate, but not raised; wall ornamented by a series of obliquely curved costae, toward the periphery gradually becoming nearly parallel to the outer edge of the test, and continuous over the chambers; aperture at the peripheral angle, with a supplementary elongate opening in the median line of the ventral face. Length, 0.5; breadth, 0.4; diameter, 0.2 mm.

Holotype.—U.S.N.M. No. 73818 (Cushman Coll. No. 15316), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a very interesting and unique species with its peculiar ornamentation, the heavy costae of the surface forming a continuous spiral independent of the individual chambers.

ROBULUS SUBALATUS (Reuss)

PLATE 7, FIGURES 1, 2

Cristellaria subalata REUSS, Denkschr. Akad. Wiss. Wien, vol. 7, pt. 1, p. 68, pl. 25, fig. 13, 1854; Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 76, pl. 8, fig. 10, pl. 9, fig. 1, 1862 (1863).

The figured specimens may be referred to this species described by Reuss from the Cretaceous of Europe. Plate 7, Figure 2, shows the more typical form in which the sutures are somewhat raised above the general surface of the test. Otherwise the general form and shape of the chambers are similar, and both specimens are marked by a very broad thin keel. Length, 1.25; breadth, 0.9; thickness, 0.5 mm.

ROBULUS MACRODISCUS (Reuss)

PLATE 7, FIGURES 3 *a*, *b*

Cristellaria macrodisca REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 78, pl. 9, figs. 5 *a*, *b*, 1862 (1863).—BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 5, p. 48, pl. 3, figs. 6–11, 1880.

Lenticulina macrodisca WHITE, Journ. Pal., vol. 2, p. 198, pl. 28, fig. 7, 1928.

Close coiled specimens, with a very large prominent umbo and an acute periphery, which is occasionally slightly keeled, occur in the Cretaceous of Trinidad and may be referred to Reuss's species. They are distinctly of the *Robulus* type, with a very prominent supplementary apertural slit as shown in the figure herein. The measurements of the figured specimen are: Length, 1.2; breadth, 1.1; thickness, 0.55 mm.

ROBULUS DISCREPANS (Reuss)

PLATE 7, FIGURES 4 *a*, *b*

Robulina discrepans REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 78, pl. 9, figs. 7 *a*, *b*, 1862 (1863).

Forms similar to that figured here are referred to Reuss's species described by him from the Upper Cretaceous of Europe. Similar ones occur in the Trinidad material. A comparison of our figured specimen with the type given by Reuss will show the very great similarity in the two. The chambers are not inflated, but gradually increase in size as added. The periphery is subacute, and the apertural face somewhat concave. The sutures are flush with the surface

and are strongly curved, continuing nearly to the periphery on the inner margin. There is a supplementary slit in the median line of the apertural face, placing this species in the genus *Robulus*, as was indicated by Reuss, who placed it in *Robulina*.

Genus LENTICULINA Lamarck, 1804

LENTICULINA NAVICULA (d'Orbigny)

PLATE 7, FIGURES 5 *a*, *b*

Cristellaria navicula D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 27, pl. 2, figs. 19, 20, 1840.—REUSS, Verstein. Böhm. Kreide, pt. 1, p. 35, pl. 12, fig. 27, 1845–46.

D'Orbigny described this species from the Cretaceous chalks of the Paris Basin, and Reuss and others have recorded it from the Cretaceous of central Europe. Our specimens from Trinidad seem to agree very well with those of Europe and may be identified with d'Orbigny's species. The chambers are distinct but not inflated, the periphery subacute, the sutures flush with the surface but strongly curved, and the apertural face convex without any supplementary slit, so that this species may be included in Lamarck's genus. There is a tendency in the later chambers toward uncoiling. The measurements of the figured specimen are as follows: Length, 0.9; breadth, 0.55; thickness, 0.4 mm.

This species is also widely distributed in the Coastal Plain region of the United States in the Upper Cretaceous.

LENTICULINA NUDA (Reuss)

PLATE 7, FIGURES 6 *a*, *b*

Cristellaria nuda REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 328, pl. 6, figs. 1–3, 1861 (1862).

Lenticulina nuda CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 96, pl. 14, fig. 2, 1928.

This species, described by Reuss from the Cretaceous of Europe and recorded by various authors from the same region, is already noted by us from Trinidad. There is no supplementary aperture so far as our material shows. The species is somewhat similar to the preceding, but the apertural face is more concave and the periphery more distinctly keeled. There is a distinct tendency to uncoiling, and the chambers are lower. Our figured specimen has the following measurements: Length, 0.8; breadth, 0.4; thickness, 0.28 mm.

Genus PLANULARIA Defrance, 1824

PLANULARIA ADVENA, new species

PLATE 8, FIGURES 1, 2

Description.—Test large, much compressed, periphery acute and slightly keeled; chambers distinct, low and broad, uniformly increas-

ing in breadth as added but with the height remaining nearly the same throughout, the later ones becoming much elongate; sutures limbate, in the early portion raised and somewhat irregularly beaded, later becoming entirely so, and in the last-formed portion even slightly depressed; wall, except for the umbilicus, which is beaded, and the raised sutures, smooth; aperture at the peripheral angle, radiate. Length, 5; breadth, 3; thickness, in the umbonal region, 0.9, at the middle of the last-formed chamber, 0.35 mm.

Holotype.—U.S.N.M. No. 73824 (Cushman Coll. No. 15317), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a large and striking species with a distinctive ornamentation. The greatest breadth is formed early in the development of the test in the umbonal region, after which it becomes complanate and much thinner.

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA GRATA (Reuss)

PLATE 7, FIGURES 7 *a*, *b*; PLATE 8, Figures 3 *a*, *b*

Cristellaria grata REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 70, pl. 7, figs. 14 *a*, *b*, 1862 (1863).—CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 598, pl. 19, figs. 1 *a*, *b*, 1926.

Lenticulina grata CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 96, pl. 14, fig. 3, 1928.

Test elongate, compressed, periphery rounded; chambers distinct, the early ones coiled, later ones uncoiling, of rather uniform shape increasing slightly in size and height as added; sutures distinct, limbate, flush with the surface, gently curved; wall smooth; aperture radiate, at the peripheral margin. Length, 1.1–1.2; breadth, 0.3–0.4; thickness, 0.2–0.25 mm.

This is a common Upper Cretaceous species known from numerous localities in Europe and widely distributed in America.

MARGINULINA MULTISEPTATA (Reuss)

PLATE 8, FIGURES 4 *a*, *b*

Cristellaria multiseptata REUSS, Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 33, pl. 2, fig. 9, 1851; Denkschr. Akad. Wiss. Wien, vol. 25, p. 147, pl. 3, figs. 14, 15, 1865.

Test longer than broad, periphery subacute, later portion uncoiling; chambers fairly distinct, very slightly if at all inflated; sutures distinct, flush with the surface, slightly curved; wall smooth; aperture radiate, at the peripheral margin. Length, 1.2–1.4; breadth, 0.6–0.75; thickness, 0.35–0.4 mm.

The figured specimen is an unusual one, showing a great irregularity in the overlapping of the chambers, which produces an unusual arrangement of the sutures from the exterior.

MARGINULINA SCHLOENBACHI (Reuss)

PLATE 8, FIGURES 5 *a*, *b*

Cristellaria schloenbachi REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 65, pl. 6, figs. 14, 15, 1862 (1863).

Test elongate, much compressed, curved, periphery rounded; chambers distinct, elongate, those of the later portion uncoiling and becoming higher and less broad; sutures distinctly curved especially toward the periphery, limbate, flush with the surface; wall smooth; aperture terminal, radiate. Length, 1.25–1.4; breadth, 0.35–0.4; thickness, 0.2–0.25 mm.

This species was originally described by Reuss from the Cretaceous of Europe, and seems to be a variable one. It has been recorded by numerous authors both from the Tertiary and as living in Recent seas.

MARGINULINA MODESTA Reuss

PLATE 8, FIGURES 6 *a*, *b*

Marginulina modesta REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 207, pl. 7, fig. 5, 1860.—FRANKE, Verh. Nat. Hist. Ver., vol. 59, p. 275, 1912 (1913).—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, no. 16, p. 506, pl. 37, figs. 8–10, 1929.

Test elongate, very little if at all compressed; the early chambers slightly coiled, later ones uncoiled and somewhat inflated, nearly circular in transverse section; sutures distinct, slightly depressed; wall smooth; aperture radiate, subterminal, somewhat toward the peripheral margin. Length, 1–1.2; thickness, 0.45–0.5 mm.

This is a common species in the Cretaceous of various parts of the world and has already been recorded from the Cretaceous of California, and it occurs in the Cretaceous of Trinidad and in the Gulf Coastal Plain region of the United States.

MARGINULINA BULLATA Reuss

PLATE 8, FIGURES 7, 8

Marginulina bullata REUSS, Verstein. Böhm. Kreide, pt. 1, p. 29, pl. 13, figs. 34–38, 1845–46; *in* Geinitz, Grundr. Verstein., p. 656, pl. 24, fig. 16, 1845–46.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 55, pl. 4, fig. 25, 1925; Abh. Preuss. Geol. Landes., vol. 111, p. 76, pl. 6, fig. 28, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 96, pl. 14, figs. 7, 8, 1928.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 507, pl. 38, figs. 4–6, 1929.

Test composed of few chambers, the earlier ones close coiled, the last two or three uncoiled and globular, all chambers strongly inflated; sutures distinct, slightly depressed; wall smooth throughout; aperture in the adult terminal, radiate. Length of adult specimens, 0.75 mm. or more.

This is a widely distributed species in the Upper Cretaceous of Europe and America. The megalospheric form has fewer chambers and the early portion often consists largely of the globular proloculum; in the microspheric form the coiling is evident and the increase of the earlier chambers less rapid.

MARGINULINA HUMILIS (Reuss)

PLATE 8, FIGURE 9

Cristellaria humilis REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 65, pl. 6, figs. 16, 17, 1862 (1863).—CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 601, pl. 19, fig. 8, 1926.

Marginulina humilis CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 505, pl. 37, figs. 3–5, 1929.

Test elongate, subcylindrical, slightly compressed; chambers distinct, the later ones only slightly inflated, of nearly uniform shape, but increasing slightly in height as added, on account of the fact that the later chambers are less involute; sutures distinct, very slightly depressed between the later chambers; wall smooth; aperture radiate and peripheral. Length, 1.2–1.5; diameter, 0.4–0.45 mm.

This is a very common species in the Cretaceous, occurring in Europe and America already known from the Velasco shale of Mexico and from the Cretaceous of California. It occurs also in the Gulf Coastal Plain Cretaceous of the United States.

MARGINULINA JONESI Reuss

PLATE 9, FIGURES 1 *a*, *b*

Marginulina jonesi REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 61, pl. 5, figs. 19 *a*, *b*, 1862 (1863).—BERTHELIN, Mém. Soc. Géol. France, sér. 3, vol. 1, p. 34, 1880.—CHAPMAN, Quart. Journ. Geol. Soc., vol. 50, p. 709, 1894; Journ. Roy. Micr. Soc., p. 164, pl. 4, fig. 24, 1894.—SHERLOCK, Geol. Mag., vol. 1, p. 259, pl. 18, fig. 15, 1914.—NEAVERSON, Geol. Mag., 1921, p. 462.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 507, pl. 38, figs. 7–9, 1929.

Test elongate, early portion compressed and chambers close coiled, later becoming uncoiled; periphery acute and keeled in the early portion; later chambers nearly circular in section; sutures more or less obscured but the ornamentation of the surface, which consists of elongate costae continuing throughout the length of the test, unbroken at the sutures, terminal face smooth; aperture in the adult

terminal, radiate, with a slight neck. Length, 0.9–1; breadth, 0.35–0.6; thickness, 0.25–0.5 mm.

This species, which is common in the Cretaceous of Europe, has only been recorded in America from the Cretaceous of California. Our specimens from Trinidad are somewhat more inflated, especially in the later chambers, but the general characters of the species are fairly constant.

MARGINULINA DECORATA (Reuss)

PLATE 9, FIGURES 2 *a*, *b*

Cristellaria decorata REUSS, Zeitschr. deutsch. geol. Ges., vol. 7, p. 209, pl. 8, fig. 16; pl. 9, figs. 1, 2, 1855.

Test elongate, compressed, the periphery lobulate; early chambers coiled, later ones uncoiled and becoming narrower as they are added; sutures distinct, limbate, raised, the earlier ones broken into a series of beadlike projections, later ones nearly entire; aperture somewhat produced, at the peripheral angle. Length, 1.5–1.65; breadth, 0.6–0.8; thickness, 0.5–0.6 mm.

This is a somewhat variable species, but the figured specimens seem to be close enough to Reuss's original types to be included under his species.

MARGINULINA TRILOBATA d'Orbigny

PLATE 9, FIGURES 3, 4

Marginulina trilobata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 16, pl. 1, figs. 16, 17, 1840.

Test elongate, the sides nearly parallel, periphery rounded; chambers distinct, rather uniform in size and shape; sutures distinct, limbate; the central portion at each side raised and thickened; wall, except for the sutural projections, smooth; aperture radiate, at the peripheral margin. Length, up to 3.5; breadth, 0.7–0.8; thickness, 0.4–0.45 mm.

The specimen figured is a megalospheric one and does not show the early coiled chambers, which are much more apparent in microspheric specimens. The raised sutures are somewhat variable in the degree of thickening, but this character is usually present in considerable degree. The types of this species were described by d'Orbigny from the Cretaceous chalks of the Paris Basin, and it is rather widely distributed in the chalky phase of the Upper Cretaceous of Europe and America.

Genus DENTALINA d'Orbigny, 1826

DENTALINA MEGAPOLITANA Reuss

PLATE 9, FIGURE 5

Dentalina megapolitana REUSS, Zeitschr. deutsch. geol. Ges., vol. 7, p. 267, pl. 8, fig. 10, 1855.

Nodosaria megapolitana FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 33, pl. 3, fig. 8, 1925.—CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 595, pl. 18, fig. 16, 1926.

Test large, fairly stout, tapering, slightly fusiform, greatest breadth developed before the last-formed chamber in the adult; chambers numerous, not inflated, distinct, of uniform shape, gradually increasing in size as added, the later ones often slightly decreasing; sutures distinct, not depressed, slightly oblique; wall smooth; aperture radiate, slightly protuberant at the inner angle of the terminal face of the last-formed chamber. Length, up to 2; breadth, up to 0.3 mm.

The figured specimen, while not typical, nevertheless may be included in this species of Reuss. The specimen is an incomplete one, and the species is found in the Trinidad Cretaceous. It has already been recorded from the Upper Cretaceous of Mexico in the Velasco shale and is common in Cretaceous deposits of the general Gulf Coastal Plain region of the United States.

DENTALINA FILIFORMIS Reuss (?)

PLATE 9, FIGURES 6, 7

The figured specimens show the early stages as well as some of the later chambers of a slender, slightly curved form which has been referred by Franke[6] to Reuss's species. This form is fairly common in the American Cretaceous of the general Gulf Coastal Plain, as well as of Trinidad.

DENTALINA CATENULA Reuss

PLATE 9, FIGURES 8 *a*, *b*

Dentalina catenula REUSS, Sitz. Akad. Wiss. Wien, vol 40, p. 185, pl. 3, fig. 6, 1860.

Test compressed, of a few chambers, slightly arcuate, rounded in transverse section; chambers distinct, inflated, subglobular; sutures depressed, distinct; wall smooth; aperture small, radiate, at the end of a distinct protuberance, at the peripheral margin of the chamber. Length, 0.6–0.75; diameter, 0.2 mm.

The chambers in this species are very much inflated and subglobular, and usually only a few of them make up the test. The aperture is especially protuberant.

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[6] Abh. Preuss. Geol. Landes., vol. 111, p. 9, pl. 2, figs. 19 *a*, *b*, 1928.

DENTALINA LEGUMEN (Reuss)

PLATE 9, FIGURE 9

Nodosaria legumen REUSS, Verstein. Böhm. Kreide, pt. 1, p. 28, pl. 13, figs. 23, 24, 1845–46; *in* Geinitz, Palaeontographica, vol. 20, pt. 2, p. 88, pl. 20, fig. 22, 1874.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 32, pl. 3, fig. 6, 1925.

Dentalina legumen REUSS, Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 26, pl. 1, fig. 14, 1851; Sitz. Akad. Wiss. Wien, vol. 40, p. 187, pl. 3, fig. 5, 1860.—FRANKE, Abh. Preuss. Geol. Landes., new ser., vol. 111, p. 27, pl. 2, fig. 23, 1928.

Test elongate, slender, tapering, slightly curved; chambers distinct, inflated, increasing rather rapidly in size as added, apertural end much extended with an elongate neck, initial chamber rounded or with a single short spine; sutures distinct, depressed, oblique; wall smooth; aperture radiate at the end of an elongate neck. Length, 0.75–0.9; breadth, 0.1–0.2 mm.

This common European Cretaceous species occurs in Trinidad and in the various portions of the Gulf Coastal Plain of the United States.

DENTALINA CONFLUENS Reuss

PLATE 9, FIGURES 10–12

Dentalina confluens REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 335, pl. 7, fig. 5, 1861 (1862).

Test elongate, slightly tapering, the early portion often somewhat compressed; later chambers becoming inflated and distinct; sutures depressed, especially in the later portion; wall ornamented by numerous rather coarse longitudinal costae, those of the early portion particularly, continuous over adjacent chambers and often somewhat oblique, later ones often broken at the sutures; aperture at the end of a distinct neck, radiate. Length, 2–2.8; diameter, 0.5–0.6 mm.

Two distinct forms are shown in the figures. The more elongate form with the somewhat twisted costae at the base is much more like the original figure of Reuss, but the other form occurs with this, and it seems that the two should be included together as variants of one species.

DENTALINA ANNULATA (Reuss)

PLATE 10, FIGURE 1

Nodosaria annulata REUSS, Geogn. Skizze Böhmen, vol. 2, pt. 1, p. 210, 1844; Verstein. Böhm. Kreide, pt. 1, p. 27, pl. 8, figs. 4, 67; pl. 13, fig. 21, 1845–46; *in* Geinitz, Palaeontographica, vol. 20, pt. 2, p. 85, pl. 20, figs. 19, 20, 1874.

Dentalina annulata REUSS, *in* Alth, Haidinger's Naturw. Abh., vol. 3, pt. 2, p. 269, pl. 13, fig. 29, 1850; vol. 4, pt. 1, p. 26, pl. 1, fig. 13, 1851.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 34, pl. 2, figs. 34, 35, 1928.

Dentalina cf. *adolphina* CUSHMAN and JARVIS (not d'Orbigny), Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 14, fig. 6, 1928.

Test much elongated, slender, tapering, greatest width toward the apertural end; chambers distinct, inflated, subglobular, increasing rather uniformly in size, the early ones somewhat less inflated; sutures distinct, depressed, more so between the later chambers; wall smooth; aperture radiate, terminal. Length, 0.8–1.25; diameter, 0.15–0.25 mm.

This species we have already recorded from Trinidad as *Dentalina* cf. *adolphina*. It seems to fit rather well the species described by Reuss from the Cretaceous of Europe and should be placed under his species.

DENTALINA sp. (?)

PLATE 9, FIGURE 13

The peculiar broken specimen figured is given simply that the record of it may be available for future workers on the Cretaceous of this area. It has very thick limbate sutures as one of its main characters.

DENTALINA sp. (?)

PLATE 10, FIGURE 3

The broken specimen figured has very coarse costae, which project somewhat at the base of each chamber and are in the later chambers projected as short spines. No complete specimens were found.

DENTALINA LORNEIANA d'Orbigny

PLATE 10, FIGURE 2

Dentalina lorneiana d'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 14, pl. 1, figs. 8, 9, 1840.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 28, pl. 2, fig. 29, 1928.

Test elongate, slightly arcuate; chambers increasing gradually in length as added until the final chamber is often twice as long as broad; sutures distinct, slightly depressed in the later portion; wall smooth; aperture terminal, radiate, very slightly projecting. Length, 1.6; diameter, 0.2 mm.

This species was originally described by d'Orbigny from the Cretaceous chalk of the Paris Basin, and it has been very widely recorded from Europe and elsewhere. It is a common species in Trinidad and in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Genus NODOSARIA Lamarck, 1816

NODOSARIA CONCINNA Reuss

PLATE 10, FIGURE 4

Nodosaria concinna REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 178, pl. 1, fig. 3, 1860.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 14, figs. 5, 11, 1928.

Test elongate, composed of a few much inflated, subglobular chambers, becoming slightly longer than broad in the later chambers, the base often with a slight spine; sutures strongly depressed; wall smooth; aperture terminal, radiate, very slightly projecting. Length, 1; maximum breadth, 0.35 mm.

This species has been widely recorded from the Cretaceous of Europe, occurs in the Cretaceous of Trinidad, and is probably widely distributed in America.

NODOSARIA LIMBATA d'Orbigny

PLATE 10, FIGURE 5

Nodosaria limbata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, p. 12, pl. 1, fig. 1, 1840.

Test composed of a few inflated chambers, slightly separated from one another by distinct but very short connections; chambers somewhat pyriform; sutures distinct, somewhat depressed; wall smooth; aperture terminal, radiate, drawn out to a subacute point.

We have already referred to this form as *Nodosaria concinna* Reuss.[7] A copy of this same specimen is given here, and it seems to fit d'Orbigny's species better than that of Reuss.

NODOSARIA LIMBATA d'Orbigny var. TUMIDATA new variety

PLATE 10, FIGURES 6 *a*, *b*

Description.—Variety differing from the typical in the shape of the chambers, which are somewhat conical, the greatest breadth being nearly at the base of the basal portion, very strongly truncated as shown in the figure.

Holotype of variety.—U.S.N.M. No. 73819 (Cushman Coll. No. 15321), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is evidently closely related to d'Orbigny's species, as there are intermediate forms present. A similar intermediate form between this variety and the typical is figured from the Velasco shale.[8]

NODOSARIA LIMBATA d'Orbigny var. BASIORNATA new variety

PLATE 10, FIGURES 7, 8

Description.—Variety differing from the typical in the ornamentation of the surface, which consists of numerous subnodose projections on the swollen portion of each chamber.

[7] Contr. Cushman Lab. Foram. Res., vol. 4, pl. 14, fig. 11, 1928.
[8] Cushman, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 597, pl. 18, fig. 6, 1926.

Holotype of variety.—U.S.N.M. No. 73820 (Cushman Coll. No. 15319), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This variety is very distinctly marked and has the greatest width of the chamber progressively becoming nearer the base as chambers are added, but less distinctly so than in the preceding variety.

NODOSARIA MONILE v. Hagenow

PLATE 10, FIGURE 9

Nodosaria monile v. HAGENOW, Neues Jahrb. für Min., 1842, p. 568.—REUSS, Verstein. Böhm. Kreide, pt. 1, p. 27, pl. 8, fig. 7, 1845–46.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 31, pl. 2, figs. 27 *a*, *b*, 1928.

Test elongate, very slightly tapering; chambers very distinct, inflated, subglobular throughout; sutures distinct, depressed especially toward the later-formed portion; wall smooth; aperture terminal, radiate, not projecting. Length, 1.5; diameter, 0.25 mm.

This species is very close to that recorded as *Nodosaria nuda.*[9] That species, however, has the chambers becoming elongate in the adult, while in *N. monile* the chambers are subglobular throughout and show little tendency to lengthen. Our specimens are very close indeed to those figured by Franke from Germany in the above reference.

NODOSARIA ORTHOPLEURA Reuss

PLATE 10, FIGURE 10

Nodosaria orthopleura REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 89, pl. 12, figs. 5 *a*, *b*, 1862 (1863).

Test very elongate, slightly tapering at each end, for most of its length with the sides parallel or nearly so; chambers numerous, not inflated; sutures fairly distinct, slightly limbate; wall ornamented by a few distinct elevated costae running from the base to the apertural end; aperture terminal, radiate.

The broken fragment shown here represents a portion of a large specimen of this species which must have measured, when complete, 8 or 10 mm. in length.

NODOSARIA PAUPERCULA Reuss

PLATE 10, FIGURES 14, 15

Nodosaria paupercula REUSS, Verstein. Böhm. Kreide, pt. 1, p. 26, pl. 12, fig. 12, 1845–46.

The two specimens figured are referred to the above species of Reuss, which he described from the Cretaceous of Germany. These

[9] Cushman and Church, Proc. California Acad. Sci., ser. 4, vol. 18, p. 510, pl. 39, figs. 4–6, 1929.

may not represent a single species, but they are characterized by the subglobular chambers and the numerous costae, which are continuous from one chamber to another.

NODOSARIA AFFINIS Reuss

PLATE 10, FIGURE 13

Nodosaria affinis REUSS, Verstein. Böhm. Kreide, pt. 1, p. 26, pl. 13, fig. 16, 1845–46; *in* Geinitz, Palaeontographica, vol. 20, pt. 2, p. 83, pl. 20, fig. 12, 1874.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 37, pl. 3, fig. 25, 1925.—BERRY and KELLEY, Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 6, pl. 1, fig. 8, 1929.

Nodosaria proxima BERRY and KELLEY (not Silvestri), Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 7, pl. 1, fig. 13, 1929.

Test elongate, of variable shape in the microspheric and megalospheric forms, the former with many chambers and tapering, the greatest width near the apertural end, the latter with the chambers of nearly uniform diameter throughout; chambers distinct, inflated, especially toward the apertural end, initial end usually with a stout spine; sutures distinct, depressed, often somewhat limbate; wall ornamented by numerous (usually 13 to 15) longitudinal costae, continuous over the adjacent chambers, usually sharp and platelike; aperture radiate, terminal, with a slight projection of the apertural face. Length, up to 2 mm. or more; diameter, normally about 0.3 mm., but in extreme megalospheric forms may be as much as 0.75 mm.

This species, described from the Upper Cretaceous of Europe, is very common indeed in the Upper Cretaceous of the Gulf Coastal Plain of the United States, and apparently our specimen figured here, although incomplete, probably belongs in the same species. There is a great degree of variation in the relative size and number of chambers in the material from the Gulf Coastal Plain, although the ornamentation remains fairly constant.

NODOSARIA cf. MARCKI Reuss

PLATE 10, FIGURE 12

Nodosaria cf. *marcki* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 14, fig. 4, 1928.

The specimen figured is the same as that given in the above reference. It is very close to a figure given by Franke from the Cretaceous of Germany.[10] Very similar specimens occur also in the Velasco shale of Mexico.

[10] Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, pl. 3, fig. 22 *a*, 1925.

NODOSARIA BREVITESTA Franke

PLATE 10, FIGURE 11

Nodosaria brevitesta FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 42, pl. 3, fig. 37, 1925.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 13, fig. 10, 1928.

Franke figures from the Cretaceous of Germany a specimen which seems close to our figured one from Trinidad. It is a short, stout form with a very few remote costae continuous over the sutures. No further material has been available to check the earlier notes on this species.

NODOSARIA VELASCOENSIS Cushman

PLATE 11, FIGURES 1–4

Nodosaria fontannesi (BERTHELIN var. *velascoensis* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 594, pl. 18 fig, 12, 1926.

Nodosaria velascoensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 97, pl. 13, figs. 15, 16, 1928.

Test elongate, subcylindrical, very slightly tapering, greatest width developed by the last-formed chamber, consisting of numerous chambers increasing in height as added, the last ones somewhat longer than broad, circular in transverse section; sutures only slightly depressed, ornamentation consisting of very fine longitudinal costae which in the early portion may be continuous, but over most of the test are restricted to the areas over the sutures. Length, up to 2.5; breadth, 0.3–0.4 mm.

This form was originally described from the Velasco shale of Mexico, where it was fairly common. It is also common in the Trinidad material and shows a considerable degree of variation, especially in the ornamentation of the test. The costae are usually somewhat spirally arranged, especially in the early portion, and in later chambers are often restricted to the area immediately adjoining the sutures.

NODOSARIA ASPERA Reuss

PLATE 11, FIGURE 5

Nodosaria aspera REUSS, Verstein. Böhm. Kreide, pt. 1, p. 26, pl. 13, figs. 14, 15, 1845–46.

Test somewhat elongate, tapering toward the initial end, greatest breadth at the last-formed chamber; chambers increasing rather uniformly as added, slightly involute, subglobular; sutures distinct, but only slightly depressed; wall ornamented with small, closely set spines covering the entire surface; aperture with a long, cylindrical neck projecting well out beyond the outline of the test. Length, up to 1.6; breadth, 0.5–0.55 mm.

The figured form agrees very closely with the species described by Reuss from the Cretaceous of Europe. It is not common in the Trinidad material, but specimens are well preserved.

NODOSARIA sp. (?)

PLATE 11, FIGURE 6

The figure shows the last two chambers of a species with a distinctive type of ornamentation in which there are prominent continuous costae and other smaller ones between. When more material is available this can probably be referred to one of Reuss's species already described from Europe, but until such material is available it is not desired to give it a definite specific name.

Genus PSEUDOGLANDULINA Cushman, 1929

PSEUDOGLANDULINA CYLINDRACEA (Reuss)

PLATE 11, FIGURES 7, 8

Glandulina cylindracea REUSS, Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 23, pl. 1, fig. 5, 1851; Sitz. Akad. Wiss. Wien, vol. 40, p. 190, pl. 4, fig. 1, 1860; vol. 44, pt. 1, p. 307, 1861 (1862); Palaeontographica, vol. 20, pt. 2, p. 89, 1872–1875 (1874).—EGGER. Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, p. 84, pl. 5, figs. 19, 20, 1899.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 511, pl. 39, figs. 8, 9, 1929.

Nodosaria cylindracea REUSS, Verstein. Böhm. Kreide, pt. 1, p. 25, pl. 13, figs. 1, 2, 1845–46.

Nodosaria (*Glandulina*) *cylindracea* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 594, pl. 18, fig. 1, 1926.

Test composed of a few subcylindrical chambers which are distinctly involute, the final chamber often being nearly twice as long as broad; sutures distinct, very slightly depressed, slightly oblique; wall smooth; aperture terminal, radiate, slightly projecting. Length, up to 3; breadth, 0.6 mm.

This species has already been recorded from the Upper Cretaceous of California and from the Velasco shale of Mexico. It is common in many parts of Europe and occurs widely distributed in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

PSEUDOGLANDULINA PARALLELA (Marsson)

PLATE 11, FIGURE 9

Glandulina parallela MARSSON, Mitth. Nat. Ver. Neu-Vorpommern. Rügen, vol. 10, p. 124, pl. 1, figs. 4 *a*, *b*, 1878.

The figured specimen may be referred to Marsson's species described from the chalk of the Island of Rügen. A similar form is figured by Franke [11] and referred to this same species. Such forms are common in the American Cretaceous and are widely distributed.

[11] Abh. Preuss. Geol. Landes., vol. 111, pl. 4, fig. 16, 1928.

PSEUDOGLANDULINA BISTEGIA (Olszewski) (?)

PLATE 11, FIGURES 10–12

Cristellaria bistegia OLSZEWSKI, Sprawozd. kom. fizyogr. Akad. umiej. Krakowie, vol. 9, p. 115, pl. 1, fig. g (error for 9), 1875.

The figured specimens show a peculiar form that may be referred to the above species with some question. Some of the specimens have a very decidedly roughened proloculum, the second chamber being smooth. The aperture in all of these specimens is somewhat broken, and its character can not be fully determined.

PSEUDOGLANDULINA sp. (?)

PLATE 11, FIGURE 13

The single specimen figured here evidently represents an ornamented species of this genus, but more material is necessary to give it a specific determination.

Genus FLABELLINA d'Orbigny, 1839

FLABELLINA RETICULATA Reuss

PLATE 11, FIGURE 15

Flabellina reticulata REUSS, Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 30, pl. 1, fig. 22, 1851; Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 326, 1861 (1862).—OLSZEWSKI, Sprawozd. kom. fizyogr. Akad. umiej. Krakowie, vol. 9, p. 110, 1875.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, p. 107, pl. 13, figs. 5–7, 1899.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 64, pl. 5, fig. 14, 1925; Abh. Preuss. Geol. Landes., vol. 111, p. 93, pl. 8, fig. 19, 1928.—WHITE, Journ. Pal., vol. 2, p. 204, pl. 28, fig. 15, 1928.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 32, pl. 4, figs. 18, 19, 1930.

Frondicularia reticulata BAGG, U. S. Geol. Survey Bull. 88, p. 50, pl. 3, fig. 6, 1898.—WELLER, Geol. Survey New Jersey, Paleontology, vol. 4, p. 230, pl. 2, fig. 30, 1907.—PLUMMER, Univ. Texas Bull. 2044, pp. 39, 172, pl. 2, fig. 5, 1927.

Flabellina favosa BEISSEL, Abh. Kön. Preuss. geol. Landes., vol. 3, p. 49, pl. 19, figs. 25–28, pl. 26, fig. 28, 1891.

Frondicularia cf. *interpunctata* CUSHMAN (not von der Marck), Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, p. 598, pl. 20, fig. 6, 1926.

Test much compressed, sides nearly or quite flat, outline of test variable, periphery truncate; early portion coiled, later chambers extending back on both sides; chambers distinct; sutures distinct, raised somewhat, the surface of the test between covered by a raised network of octagonal meshes with the long axis at right angles to the sutures; aperture slightly produced.

This is a widely distributed species in Europe and America and is abundant in the Navarro formation of Texas and equivalent formations of Arkansas and Tennessee.

FLABELLINA SEMIRETICULATA Cushman and Jarvis

PLATE 11, FIGURE 14

Flabellina semireticulata CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 98, pl. 13, fig. 14, 1928.

Test rhomboid in front view, much compressed, apertural end extended; chambers and sutures obscured by the surface ornamentation, which consists of a more or less irregular reticulation, the sides of the polygonal areas raised, thin and platelike. Length, 0.6; breadth, 0.35; thickness, 0.08 mm.

This form was described by us as a new species in the above reference. It is to be suspected that it may be only a form of the preceding species, but more material is necessary to determine this point definitely.

FLABELLINA INTERPUNCTATA von der Marck

PLATE 12, FIGURE 1

Flabellina interpunctata VON DER MARCK, Verh. nat. Ver. preuss. Rheinl., vol. 15, p. 53, pl. 1, fig. 5, 1858.—REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 216, pl. 9, fig. 1, 1860.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., p. 422, pl. 8, fig. 5, 1910.—FRANKE, Bronn. Verh. Nat. Hist. Ver., vol. 59, p. 277, 1912 (1913).—CHAPMAN, Bull. Geol. Surv., Western Australia, No. 72, p. 34, pl. 10, fig. 91, 1917.—FRANKE, Abh. geol. pal. Inst. Univ. Greifswaid, vol. 6. p. 64, pl. 5, fig. 13, 1925; Jahrb. preuss. Geol. Landes., vol. 48, p. 678, 1927; Abh. preuss. Geol. Landes., vol. 111, p. 92, pl. 8, fig. 17, 1928.—WHITE, Journ. Pal., vol. 2, p. 203, 1928.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 30, pl. 4, figs. 16, 17, 1930.

Flabellina rugosa BEISSEL (not d'Orbigny), Abh. Kön. Preuss. geol. Landes., vol. 3, p. 47, pl. 9, figs. 20–24, 1891.

Frondicularia projecta CARSEY, Univ. Texas Bull. 2612, p. 41, pl. 6, fig. 5, 1926.

Frondicularia baudouiniana CUSHMAN (not d'Orbigny), Contr. Cushman Lab. Foram. Res., vol. 2, p. 21, pl. 3, fig. 5, 1926; Journ. Pal., vol. 1, p. 155, pl. 24, fig. 13, 1927.

Test sagittate to rhomboid in outline, much compressed, sides nearly flat, periphery truncate; early chambers coiled, later ones extending back on both sides; sutures raised and sharp, later chambers with a loop or series of loops at the apical end of the chamber; wall between the raised sutures with a series of small papillae; apertural end slightly projecting.

This is a very characteristic species with its raised, clear-cut sutures and the papillate wall. The peculiar looplike extensions in the median line in the adult are also characteristic even if the papillae are covered.

The species is very widely distributed and is naturally subject to considerable variation. The main characters, however, remain constant, and its vertical range is considerable.

FLABELLINA ELLIPTICA (Nilsson)

PLATE 12, FIGURE 2

Planularia elliptica NILSSON, Petr. Suec. form. cret., p. 11, pl. 9, figs. 21, 22, 1827.
Flabellina elliptica FRIC, Stud. Geb. Böhm. Kreide., vol. 2, p. 149, fig. 152 (in text), 1877.—FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 91, pl. 8, figs. 14, 15, 1928.

Test somewhat rhomboid in outline, the early portion distinctly coiled; sutures distinct, slightly limbate, but hardly if at all depressed; wall very smooth. Length, 4; breadth, 3.25 mm.

The very broad, large, smooth form figured here may be referred to the above species, although the early figures are not very definite. A similar form occurs in the Cretaceous of the Gulf Coastal Plain of the United States.

Genus FRONDICULARIA Defrance, 1824

FRONDICULARIA ELONGATA White (?)

PLATE 12, FIGURE 3

Frondicularia archiaciana CUSHMAN (not d'Orbigny), Contr. Cushman Lab. Foram. Res., vol. 2, p. 21, pl. 3, fig. 4, 1926.
Frondicularia sp. (?) CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 598, pl. 20, fig. 2, 1926.
Frondicularia elongata WHITE, Journ. Pal., vol. 2, p. 205, pl. 29, fig. 3, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 98, pl. 14, fig. 1, 1928.

This species described from the Upper Cretaceous of Mexico is also found in the Trinidad collection. The figure given by White shows the costae only between the sutures, and the description reads "with longitudinal ribs crossing the interspaces" as if they were independent on the different chambers. His figure also seems to clearly indicate that the costae are independent of one another on different chambers, as will be seen especially on the left side of the specimen that the different series are not at all aligned. If the figure and description are accurate, it would seem that *F. elongata* is a synonym of *F. decheni* Reuss from the Cretaceous of Germany, and that our species figured here from Trinidad and from Mexico is another species.

The above notes are from our earlier paper. No further material has been found that will help to solve the problem of the identity of this species.

FRONDICULARIA CORDAI Reuss

PLATE 12, FIGURE 4

Frondicularia cordai REUSS, Verstein. Böhm. Kreide, pt. 1, p. 31, pl. 8, figs. 26–28, pl. 13, fig. 41, 1845–46; pt. 2, p. 108, pl. 24, fig. 38, 1845–46.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 34, pl. 5, fig. 17, 1930.

There is a single fragment here that may be referred to Reuss's species. The surface is very finely costate. The species is known from the Gulf Coastal Plain of the United States.

FRONDICULARIA GRACILIS Franke (?)

PLATE 12, FIGURE 5

Frondicularia angusta REUSS (not Nilsson), Sitz. Akad. Wiss. Wien, vol. 40, p. 196, pl. 4, fig. 5, 1860.

Frondicularia archiaciana d'ORBIGNY var. *strigillata* BAGG (not *F. strigillata* Reuss), U. S. Geol. Survey Bull. 88, p. 47, pl. 3, fig. 5, 1898.

Frondicularia gracilis FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 50, pl. 4, fig. 9, 1925.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, p. 37, pl. 5, fig. 16, 1930.

The single fragment figured here is more finely ornamented than is typical of Franke's species, but until further material is obtained it is referred here.

Subfamily LAGENINAE

Genus LAGENA Walker and Jacob, 1798

LAGENA ORBIGNYANA (Seguenza)

PLATE 12, FIGURE 6

Very similar specimens of that figured here were found in the Velasco shale material in Mexico and referred to Seguenza's species. The central body of the test is smooth in distinction from the following variety.

LAGENA ORBIGNYANA (Seguenza) var.

PLATE 12, FIGURES 7 *a*, *b*

This form, with the body of the test covered with longitudinal costae, seems to be identical with a similar form already recorded [12] from the Velasco shale of Mexico.

Family POLYMORPHINIDAE

Genus GUTTULINA d'Orbigny, 1826

GUTTULINA ADHAERENS (Olszewski)

PLATE 12, FIGURES 8 *a*, *b*

Polymorphina adhaerens OLSZEWSKI, Sprawodz. kom. fizyogr. Akad. umiej. Krakowie, vol. 9, p. 119, pl. 1, fig. 11, 1875.

Guttulina adhaerens CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, art. 6, p. 36, pl. 1, figs. 9 *a–c*; pl. 6, figs. 7 *a*, *b*, 1930.

[12] Cushman, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 593, pl. 17, fig. 13, 1926.

The figured specimen may be referred to this Cretaceous species, which is variable in the form of the chambers. One side is decidedly flattened, giving the test the appearance of having been attached.

Genus PSEUDOPOLYMORPHINA Cushman and Ozawa, 1928

PSEUDOPOLYMORPHINA OZAWANA, new species

PLATE 12, FIGURES 9 *a*, *b*

Description.—Test elongate, very much compressed; early chambers somewhat thicker than the later ones, which are definitely biserial; sutures raised and subnodose; wall between the sutures smooth; aperture terminal, radiate. Length, 2.5; breadth, 1; thickness, 0.5 mm.

Holotype.—U.S.N.M. No. 73821 (Cushman Coll. No. 15324), from Upper Cretaceous of pit at Lizard Springs, near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a peculiar highly ornamented species of the genus and very distinct from any other known Cretaceous form. It is named for the late Prof. Yoshiaki Ozawa, who has contributed so much to the knowledge of this family.

Genus RAMULINA Rupert Jones, 1875

RAMULINA sp. (?)

PLATE 12, FIGURES 10, 11

The two spinose forms figured here may be referred to the genus *Ramulina*, but without further material it seems rather useless to give this a definite specific name.

Family NONIONIDAE

Genus NONION Montfort, 1808

NONION CRETACEUM, new species

PLATE 12, FIGURES 12 *a*, *b*

Description.—Test closely coiled, compressed, very slightly umbilicate, periphery subacute; chambers distinct, eight making up the adult coil, of uniform shape increasing very slightly in size as added; sutures distinct, limbate, very slightly curved; wall smooth, the central umbilical region covered with a layer of clear shell material, in which are tubular spaces connecting with the umbilici, represented by lighter spaces in the clear material; aperture narrow, at the base of the last-formed chamber. Diameter, 0.65; thickness, 0.25 mm.

Holotype.—U. S. N. M. No. 73822 (Cushman Coll. No. 15327) from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

Remarks.—This is a very peculiar species of the genus, and unlike any other described form. It has very limbate sutures and a peculiar arrangement of the umbilical region, with its thickening of clear shell material pierced by irregularly curved tubular openings.

Family CAMERINIDAE

Genus OPERCULINA d'Orbigny, 1826

OPERCULINA CATENULA, new species

PLATE 12, FIGURES 13 *a*, *b*

Description.—Test broadly complanate, periphery rounded, greatest thickness in the umbonal region; chambers distinct, about 15 in the last-formed coil, of rather uniform shape and increasing somewhat in length as added; sutures distinct, limbate, raised, ornamented by numerous beadlike protuberances which are slightly elongate in the line of the suture, sutures ending in the umbonal region in a distinct boss which itself is somewhat beaded; wall between the sutures smooth. Diameter, 2.25; thickness, 0.6 mm.

Holotype.—U.S.N.M. No. 73823 (Cushman Coll. No. 15325), from Upper Cretaceous of pit at Lizard Springs near Guayaguayare, southeastern Trinidad, British West Indies.

This is one of the few species of this genus known from the Upper Cretaceous, and it seems to be a very distinctive one as developed in this Upper Cretaceous of Trinidad.

Family HETEROHELICIDAE

Genus GÜMBELINA Egger, 1899

GÜMBELINA sp. (?)

PLATE 13, FIGURES 1 *a*, *b*

There are a few very poorly preserved specimens of *Gümbelina*, which it seems unwise definitely to place under a specific name. The surface is not usually well preserved, and it may possibly be that they are reworked specimens from some older Cretaceous source.

Genus BOLIVINOIDES Cushman, 1927

BOLIVINOIDES DECORATA (Jones) var. DELICATULA Cushman

PLATE 13, FIGURE 2

Bolivina decorata CUSHMAN (not Jones), Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 19, pl. 2, figs. 3 *a*, *b*, 1926.

Bolivinoides decorata (JONES) var. *delicatula* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, p. 90, pl. 12, fig. 8, 1927; Journ. Pal., vol. 1, p. 158, pl. 28, fig. 7, 1927.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 99, pl. 14, fig. 9, 1928.

This elongate variety, which has already been recorded from the Velasco shale of Mexico, occurs in typical form in Trinidad. The ornamentation of the surface is shown in the figure, and it is quite distinct from typical *B. decorata* (Jones) as developed in Europe.

BOLIVINOIDES TRINITATENSIS Cushman and Jarvis

PLATE 13, FIGURES 3 *a*, *b*

Bolivinoides trinitatensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 99, pl. 14, figs. 10 *a*, *b*, 1928.

Test generally biserial, broadest near the apertural end, tapering to the subacute initial end, whole test thickening rapidly toward the apertural end, which is formed of a smooth thickened area; chambers marked by the highly ornate character of the test, consisting of thin convex platelike extensions backward from the thickened terminal face of the chamber having a deep area below, with trusslike raised costae, the areas over the chambers deeply depressed; aperture a somewhat elongate opening marking the suture which is otherwise obscured by the thickening of the apertural end of the test. Length, 0.6; breadth, 0.38; thickness, 0.2 mm.

The figured specimen, which is the holotype, does not show such a great development of the platelike extensions and the very deep excavations below them as do some of the other specimens from the same locality. This is one of the most highly ornamented species of the genus and is closely allied to *B. velascoensis* (Cushman), described from the Velasco shale of Mexico.

Genus SPIROPLECTOIDES Cushman, 1927

SPIROPLECTOIDES CLOTHO (Grzybowski)

PLATE 13, FIGURES 5, 6

Spiroplecta clotho GRZYBOWSKI, Rozprawy Wydz. mat. przyr., vol. 41, p. 283, pl. 7, fig. 18, 1901.

Spiroplecta annectens CUSHMAN (not Parker and Jones), Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 584, pl. 15, figs. 4 *a*, *b*, 1926.

Spiroplectoides clotho CUSHMAN, Journ. Pal., vol. 1, p. 159, pl. 28, fig. 6, 1927.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 101, pl. 14, figs. 13, 14, 1928.

Our specimens from Trinidad are very excellently preserved and show especially well the sutures, which are somewhat limbate. The two figures show the difference in shape and size of the microspheric and megalospheric forms. When seen separately the two might easily be mistaken for two distinct species.

Family BULIMINIDAE

Genus BULIMINA d'Orbigny, 1826

BULIMINA TRINITATENSIS Cushman and Jarvis

PLATE 13, FIGURES 4 *a*, *b*

Bulimina trinitatensis CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 102, pl. 14, figs. 12 *a*, *b*, 1928.

Test somewhat longer than broad, rounded in transverse section; chambers distinct with the lower border extended into an overhanging plate, which is marked on the upper side by an irregular network of reticulate areas, the outer angles ending in short spines; aperture elongate, comma-shaped, the apertural face smooth. Length, 0.5; diameter, 0.3 mm.

The ornamentation of this species is very distinctive and will distinguish it from any described species of the genus. The same species is apparently developed in the Gulf Coastal Plain region of the United States, or at least a very similar one occurs there.

Genus LOXOSTOMUM Ehrenberg, 1854

LOXOSTOMUM PLAITUM (Carsey)

PLATE 13, FIGURE 7

Bolivina plaita CARSEY, Univ. Texas Bull. 2612, p. 26, pl. 4, fig. 2, 1926.
Proroporus plaita CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, p. 89, pl. 12, figs. 7 *a*, *b*, 1927.

This species is now widely known from the Cretaceous of the Western Hemisphere, occurring in its typical form in the Navarro and its equivalent in the Gulf Coastal Plain region of the United States.

Family ELLIPSOIDINIDAE

Genus PLEUROSTOMELLA Reuss, 1860

PLEUROSTOMELLA CLAVATA Cushman

PLATE 13, FIGURES 8 *a*, *b*

Pleurostomella clavata CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, no. 6, p. 590, pl. 16, fig. 5, 1926; Contr. Cushman Lab. Foram. Res., vol. 3, p. 132, pl. 25, fig. 19, 1927.—WHITE, Journ. Pal., vol. 2, p. 52, pl. 5, fig. 14, 1928.

Test somewhat fusiform, nearly circular in transverse section, greatest diameter toward the apertural end, periphery very slightly, if at all, lobulate, composed of a few chambers; the sutures distinct but not depressed; wall smooth, finely perforate; aperture at the

base of the last-formed chamber, very large, arched. Length, 0.65–1; diameter, 0.25–0.45 mm.

This species is now known from the Velasco shale of Mexico, from which it was originally described, from the Upper Cretaceous of Trinidad, and from the Gulf Coastal Plain of the United States.

Genus ELLIPSOPLEUROSTOMELLA A. Silvestri, 1903

ELLIPSOPLEUROSTOMELLA CURTA Cushman

PLATE 13, FIGURES 9, 10

Ellipsopleurostomella curta CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 590, pl. 16, figs. 6 *a*, *b*, 1926.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 102, pl. 14, figs. 18, 19, 1928.

The somewhat irregular specimens shown are possibly both forms of this species, but one of them has developed a chamber with a terminal aperture, and it may belong elsewhere.

Genus ELLIPSONODOSARIA A. Silvestri, 1900

ELLIPSONODOSARIA SUBNODOSA (Guppy)

PLATE 13, FIGURES 11–13

Ellipsoidina subnodosa GUPPY, Proc. Zool. Soc. London, 1894, p. 650, pl. 41, fig. 12.

Ellipsonodosaria subnodosa NUTTALL, Quart. Journ. Geol. Soc., vol. 84, p. 95, pl. 6, fig. 20, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 102, pl. 14, figs. 15, 16, 1928.

The two forms given may represent the microspheric and megalospheric forms of the same species. The adult chambers are very similar in all the specimens.

Genus ELLIPSOGLANDULINA A. Silvestri, 1900

ELLIPSOGLANDULINA EXPONENS (H. B. Brady)

PLATE 13, FIGURES 14–16

Ellipsoidina exponens H. B. BRADY, *in* Jukes-Brown and Harrison, Quart. Journ. Geol. Soc., vol. 48, p. 198, 1892.—GUPPY, Proc. Zool. Soc. London, 1894, p. 650, pl. 41, fig. 13.

Ellipsoglandulina exponens A. SILVESTRI, Atti Pont. Accad. N. Lincei, vol. 54, pp. 103–109, 1901.—NUTTALL, Quart. Journ. Geol. Soc., vol. 84, p. 95, pl. 6, fig. 17, 1928.—CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, p. 103, pl. 14, fig. 17, 1928.

The various specimens given may represent forms of a single species. Some of them are evidently megalospheric, while others represent the microspheric form.

Family ROTALIIDAE

Genus VALVULINERIA Cushman, 1926

VALVULINERIA ALLOMORPHINOIDES (Reuss)

PLATE 14, FIGURES 2*a–c*

Valvulina allomorphinoides REUSS, Sitz. Akad. Wiss. Wien, vol. 40, p. 223, pl. 11, figs. 6 *a–c*, 1860.

Discorbina allomorphinoides FRANKE, Abh. geol. pal. Inst. Univ. Greifswald, vol. 6, p. 91, pl. 8, figs. 11 *a*, *b*, 1928; Abh. Preuss. Geol. Landes., vol. 111, p. 189, pl. 18, figs. 7 *a*, *b*, 1928.

Discorbis allomorphinoides CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 606, pl. 20, figs. 18, 19; pl. 21, fig. 5, 1926.

Test biconvex, slightly longer than broad, oval, periphery rounded; chambers distinct, on the dorsal side with the earlier whorls visible, ventrally involute, usually five in the last-formed whorl; sutures distinct, dorsally slightly curved, not depressed, ventrally slightly curved, slightly depressed; wall smooth; aperture narrow, below an overhanging flat, platelike lip.

The figured specimen, while somewhat more open in its coiling than is usual in this species, may possibly be included in its range of variation.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA DEPRESSA (Alth)

PLATE 14, FIGURES 1 *a–c*

Rotalina depressa ALTH, Haidinger's Naturw. Abh., vol. 3, p. 266, pl. 13, fig. 21, 1850.

Gyroidina depressa CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 515, pl. 41, figs. 4–6, 1929.

Rotalia cretacea CARSEY, Univ. Texas Bull. 2612, p. 48, pl. 5, figs. 7 *a*, *b*, 1926.

Rotalia beccarii (LINNAEUS) var. *ripleyensis* W. BERRY, *in* Berry and Kelley, Proc. U. S. Nat. Mus., vol. 76, art. 19, p. 15, pl. 3, figs. 10–12, 1929.

Test much compressed, trochoid, biconvex, the dorsal side often nearly flat, periphery rounded, umbilicus often open; chambers numerous, 10 to 12 in the last-formed whorl, distinct; sutures distinct, on the dorsal side nearly flush with the surface, slightly limbate, curved, ventrally slightly curved, nearly radial, slightly depressed; wall smooth; aperture on the ventral side between the periphery and the umbilicus, low. Diameter, 0.25–0.45; height, 0.1–0.2 mm.

This is one of the common species of the Upper Cretaceous and is very widely distributed in Europe and America. It has had various names.

GYROIDINA NITIDA (Reuss)

PLATE 14, FIGURES 2*a–c*

Rotalina nitida REUSS, Geogn. Skizze Böhmen, vol. 2, pt. 1, p. 214, 1844; Verstein. Böhm. Kreide, pt. 1, p. 35, pl. 8, fig. 52; pl. 12, figs. 8, 20, 1845–46.
Gyroidina sparksi WHITE, Journ. Pal., vol. 2, p. 297, pl. 40, fig. 8, 1928.

Our specimens may be referred to this somewhat variable species of Reuss. The figures show the general characters, but there are intermediate forms that tend toward the following species.

GYROIDINA GLOBOSA (v. Hagenow)

PLATE 14, FIGURES 3, 4

Nonionina globosa v. HAGENOW, Neues Jahrb. für Min., 1842, p. 574.
Rotalia globosa REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 330, pl. 7, figs. 2 *a*, *b*, 1861 (1862).
Gyroidina naranjoensis WHITE, Journ. Pal., vol. 2, p. 296, pl. 40, fig. 5, 1928.

In its typical form this species has a very broadly rounded periphery, and the ventral side is deep. Intermediate forms seem to be present between this and the preceding species. The form is widely distributed in the Upper Cretaceous.

Genus EPONIDES Montfort, 1808

EPONIDES HAIDINGERII (d'Orbigny)

PLATE 14, FIGURES 5 *a–c*

Rotalina haidingerii D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, p. 154, pl. 8, figs. 7–9, 1846.

Test nearly circular in outline, in side view with a fairly high spire, dorsal side very convex, ventral side flattened or sometimes somewhat concave, periphery rounded; chambers in several whorls, about six or seven in the adult whorl, distinct, slightly inflated on the ventral side; sutures on the dorsal side slightly limbate, oblique, flush with the surface, on the ventral side slightly depressed, nearly radiate; wall smooth, distinctly perforate; aperture ventral between the umbilicus and the periphery, with a slight lip. Diameter, 0.5–0.8; height, 0.3–0.35 mm.

The Trinidad specimens are very close to d'Orbigny's species from the Vienna Basin and seem to be identical with it. Similar specimens occur in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Family CASSIDULINIDAE

Subfamily CERATOBULIMININAE

Genus PULVINULINELLA Cushman, 1926

PULVINULINELLA VELASCOENSIS (Cushman)

PLATE 14, FIGURES 6 *a–c*

Truncatulina velascoensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 1, p. 20, pl. 3, fig. 2, 1925; Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 606, pl. 21, fig. 8, 1926.

Rotalia velascoensis WHITE, Journ. Pal., vol. 2, p. 290, pl. 39, figs. 5 *a–c*, 1928.

Test nearly bilaterally symmetrical with a very thin, broad keel; chambers all visible from the dorsal side, only those in the last-formed coil from the ventral side, about 10 chambers in the last-formed coil, fewer in the earlier ones; chambers distinct, especially from the ventral side; sutures on the dorsal side raised and confluent, on the ventral side slightly depressed, curved; wall smooth on the ventral side, the dorsal side with an excavated area over each chamber; aperture elongate, narrow, on the ventral side of the last-formed chamber nearly in the axis of coiling. Diameter, up to 1.2; height, 0.4 mm.

This is a common species in the Velasco formation of Mexico and occurs in typical form in the Cretaceous of Trinidad. The position of the aperture places this species in the genus *Pulvinulinella.*

PULVINULINELLA ALATA (Marsson)

PLATE 15, FIGURES 1, 2

Discorbina alata MARSSON, Mitth. Nat. Ver. Neu-Vorpommern Rügen, vol. 10, p. 165, pl. 4, figs. 33 *a–d*, 1878.

Pulvinulina alata FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 185, pl. 17, figs. 8 *a–c*, 1928.

Gyroidina florealis WHITE, Journ. Pal., vol. 2, p. 298, pl. 40, figs. 3 *a–c*, 1928.

Test plano-convex, the ventral side very strongly convex, dorsal side flattened or even slightly concave except in the center, which is slightly raised, periphery strongly keeled and developing a flat carina, which is often broken; chambers usually about six or seven in the last-formed whorl, distinct, inflated on the ventral side, but very slightly, if at all, on the dorsal side; sutures distinct, those of the ventral side sigmoidally curved and very slightly depressed, those of the dorsal side strongly oblique, distinctly limbate; wall smooth, but distinctly perforate; aperture ventral close to and parallel with the peripheral margin. Diameter, 0.9–1; height, 0.5 mm.

This species was originally described by Marsson from the Upper Cretaceous of the Island of Rügen. It has also been recorded from

the Cretaceous of Germany by Franke and is apparently the same as the species recorded by White from the Velasco shale of Mexico. The figured specimens from the Upper Cretaceous of Trinidad show well the general characters of the species.

Family CHILOSTOMELLIDAE

Subfamily ALLOMORPHININAE

Genus ALLOMORPHINA Reuss, 1850

ALLOMORPHINA TROCHOIDES (Reuss)

PLATE 15, FIGURES 3 *a–c*

Globigerina trochoides REUSS, Verstein. Böhm. Kreide, pt. 1, p. 36, pl. 12, fig. 22, 1845–46; Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 37, pl. 3, fig. 5, 1851.

Valvulina trochoides FRANKE, Abh. Preuss. Geol. Landes., vol. 111, p. 162, pl. 15, figs. 2 *a–c*, 1928.

Test triserial, consisting of a conical early portion and an inflated later portion made up of the last three chambers in the adult; chambers of the early portion rather indistinct, last three greatly inflated and subglobular; sutures of the last portion distinct and depressed, early ones obscure; wall smooth; aperture an elongate slit at the base of the last-formed chamber. Length, 0.35; diameter, 0.3–0.35 mm.

This is a very peculiar little species, but it has a very wide distribution in the Upper Cretaceous of Europe and America. Reuss placed it as a *Globigerina*, but it evidently does not belong in that genus. Franke has placed it in *Valvulina*, but it seems to have a calcareous, perforate test. The triserial character of the test and the type of the aperture seem to show that this species should be placed as a primitive species of *Allomorphina* with a very high spire.

Subfamily ALLOMORPHINELLINAE

Genus PULLENIA Parker and Jones, 1862

PULLENIA QUINQUELOBA (Reuss)

PLATE 15, FIGURES 4 *a, b*

Nonionina quinqueloba REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, p. 71, pl. 5, fig. 31, 1851.

Pullenia quinqueloba H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 617, pl. 84, figs. 14, 15, 1884.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 18, p. 517, pl. 41, figs. 10, 11, 1929.

Test planispiral in the adult, completely involute, compressed, periphery rounded; chambers typically five in the last-formed coil, increasing gradually in size as added, only slightly inflated; sutures

distinct, very slightly depressed, radial; wall smooth; aperture at the base of the apertural face of the chamber, either an elongate slit or a somewhat constricted opening with a slight lip. Diameter, 0.35–0.45; thickness, 0.2–0.25 mm.

This species has been recorded from Cretaceous to Recent, and there may be more than one species in the series, although there is some variation in all the series studied. The figured specimen shows well the common Cretaceous form, which is widely distributed in Europe and America.

PULLENIA CORYELLI White

PLATE 15, FIGURES 5 *a*, *b*

Pullenia sphaeroides CUSHMAN (not d'Orbigny), Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 605, pl. 21, figs. 2 *a*, *b*, 1926.

Pullenia coryelli WHITE, Journ. Pal., vol. 3, p. 56, pl. 5, fig. 22, 1929.

Test subspherical, periphery very broadly rounded, slightly umbilicate; chambers distinct but not inflated, six or seven in the final coil; sutures distinct, very slightly if at all depressed; wall smooth; aperture an elongate curved slit, at the base of the apertural face. Diameter, up to 0.5 mm.

This seems to be a widely distributed form in the American Cretaceous, it being recorded from the Velasco shale of Mexico and also occurring in Trinidad.

Family GLOBIGERINIDAE

Subfamily GLOBIGERININAE

Genus GLOBIGERINELLA Cushman, 1927

GLOBIGERINELLA sp. (?)

PLATE 15, FIGURES 6 *a*, *b*

Rare specimens of this genus occur in the Trinidad Cretaceous, but specimens are not in sufficient numbers and completeness to give full characters for specific determination.

Family GLOBOROTALIIDAE

Genus GLOBOTRUNCANA Cushman, 1927

GLOBOTRUNCANA ARCA (Cushman)

PLATE 15, FIGURES 7 *a–c*

Pulvinulina arca CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, p. 23, pl. 3, figs. 1 *a–c*, 1926.

Globotruncana arca CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, p. 91, pl. 19, fig. 11, 1927; Journ. Pal., vol. 1, p. 169, pl. 28, fig. 28, 1927.—MOREMAN, Journ. Pal., vol. 1, p. 100, pl. 16, figs. 16, 17, 1927.—CUSHMAN and CHURCH, Proc. California Acad. Sci., ser. 4, vol. 8, p. 518, pl. 41, figs. 1–3, 1929.

Globigerina rosetta CARSEY, Univ. Texas Bull. 2612, p. 44, pl. 5, figs. 3 *a–c*, 1926.

This is one of the common species of the Upper Cretaceous of Mexico, Trinidad, and the Gulf Coastal Plain of the United States.

GLOBOROTALIA VELASCOENSIS (Cushman)

PLATE 15, FIGURES 8 *a–c*

Pulvinulina velascoensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 1, p. 19, pl. 3, figs. 5 *a–c*, 1925.
Globorotalia velascoensis CUSHMAN, Journ. Pal., vol. 1, pt. 2, p. 169, pl. 27, figs. 7–9, 1927.—WHITE, Journ. Pal., vol. 2, p. 281, pl. 38, figs. 2 *a–c*, 1928.

This is a somewhat variable species with a fairly long range in the Velasco shale of Mexico. There is a considerable variation in the degree of the projection about the umbilical region of the ventral side and the convexity of the dorsal surface and the amount of projection of the periphery. The figured specimen is from the Cretaceous of Lizard Springs.

Family ANOMALINIDAE

Subfamily ANOMALININAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA AMMONOIDES (Reuss)

PLATE 16, FIGURES 1 *a–c*

Rosalina ammonoides REUSS, Geogn. Skizze Böhmen, vol. 2, pt. 1, p. 214, 1844; Verstein. Böhm. Kreide, pt. 1, p. 36, pl. 8, fig. 53, pl. 13, fig. 66, 1845–46; Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 36, pl. 3, fig. 2, 1851.

The early references to this species are given above. Originally described from the Cretaceous of Europe, it has been used by many authors to include a wide variety of forms from Cretaceous to Recent, many of which have little in common with the types. The accompanying figures illustrate a Trinidad species, which seems very close to Reuss's species and to which we are applying his name.

ANOMALINA POLYRRAPHES (Reuss)

PLATE 16, FIGURES 2 *a–c*

Rotalina polyrraphes REUSS, Verstein. Böhm. Kreide, pt. 1, p. 35, pl. 12, fig. 18, 1845–46; Haidinger's Naturw. Abh., vol. 4, pt. 1, p. 35, pl. 3, fig. 1, 1851.
Cibicides risseri WHITE, Journ. Pal., vol. 2, p. 298, pl. 40, figs. 10 *a–c*, 1928.

The figures represent a species from Trinidad that also occurs in the Velasco shale of Mexico and in the Gulf Coastal Plain region of the United States. It seems to be identical with the species described by Reuss from the Cretaceous of Europe. There is a slight tendency toward becoming evolute, but this is apparently never carried to the point where the species can be placed in the genus *Planulina*. Our

figured specimen is slightly irregular in the last three chambers, but usually these are very uniform in size and shape, the periphery broadly rounded and the sutures distinct and somewhat limbate.

ANOMALINA RUBIGINOSA Cushman

PLATE 16, FIGURES 3–5

Anomalina rubiginosa CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 607, pl. 21, figs. 6 *a–c*, 1926.

Planulina rubiginosa WHITE, Journ. Pal., vol 2, p. 303, pl. 41, figs. 6 *a–c*, 1928.

Test close coiled, the dorsal side slightly convex, ventral side somewhat concave, periphery broadly rounded, 9 or 10 chambers in the last-formed coil, rather indistinct, as are also the sutures, more distinct in the last few chambers, dorsal side with the wall very coarsely punctate, ventral side, especially in the earlier portion, with very large depressed areas of an irregular form, giving a peculiar appearance to that portion of the test; aperture along the ventral margin of the last-formed chamber. Diameter, 0.5–0.8; height, 0.3–0.4 mm.

This is a common and well-marked species in the Velasco shale of Mexico and occurs in typical form in the Trinidad material. Some of the young stages are also shown here. So far as our material from both areas shows the species does not become sufficiently evolute to warrant placing it in the genus *Planulina*.

Genus PLANULINA d'Orbigny, 1826

PLANULINA CONSTRICTA (v. Hagenow)

PLATE 16, FIGURES 6 *a–c*

Rotalia constricta v. HAGENOW, Neues Jahrb. für Min., 1842, p. 571.—REUSS Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 329, pl. 6, fig. 7, 1861 (1862).

The accompanying figures are of a specimen typical of a Trinidad species that seems identical with that of von Hagenow as figured by Reuss. It is much compressed, has numerous chambers, and in the adult becomes somewhat evolute on both sides. The dorsal side has a thickened umbonal region with a thickened ring about it outside a deep groove.

Similar forms occur widely distributed in the American Cretaceous. It rather remotely resembles *Planulina taylorensis* (Carsey), but that is a more evolute form and keeled, with numerous differences.

PLANULINA SCHLOENBACHI (Reuss)

PLATE 16, FIGURES 7 *a–c*

Rotalia schloenbachi REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, p. 84, pl. 10, figs. 5 *a–c*, 1862 (1863).

Test much compressed, evolute, periphery subacute, both sides somewhat umbonate; chambers distinct, numerous, of uniform shape,

gradually increasing in size as added; sutures distinct, curved, limbate, and raised; wall of the chambers smooth, coarsely perforate, umbo very coarsely pitted; aperture peripheral and extending over onto the dorsal side. Length, 0.8; breadth, 0.7; thickness, 0.3 mm.

This species with its strongly raised sutures and coarsely pitted umbos seems to be identical with that described by Reuss from the Cretaceous of Europe in the reference given above. It is a very distinctive form.

PLANULINA sp. (?)

PLATE 16, FIGURES 8 *a–c*

The specimen figured seems to have characters in common with that described by Reuss [13] from Europe as "*Rotalia involuta*," and with "*Rotalia mortoni*" [14] from the Cretaceous of New Jersey, but more material is needed for determining the full characters of this form.

[13] Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, p. 313, pl. 2, figs. 4 *a, b*, 1861 (1862).
[14] Idem, p. 337, pl. 8, figs. 1 *a–c*.

EXPLANATION OF PLATES

Plate 1

Figures 1, 2. *Rhabdammina discreta* H. B. Brady, × 40.
3. *Saccammina rhumbleri* (Franke) (?), × 40.
4–6. *Pelosina complanata* Franke, × 35. Figures 4 and 6, composed largely of cement and with smooth surface. Figure 5, specimen with a roughened surface of angular fragments.
7, 8. *Hyperammina elongata* H. B. Brady, × 40.
9. *Hyperammina* (?) sp. (?), × 35.
10–12. *Saccorhiza ramosa* (H. B. Brady), × 35. Broken fragments showing characteristic curvature of the test and roughened surface.
13. *Reophax* sp. (?), × 40.
14. *Hormosina globulifera* H. B. Brady, × 35.
15–17. *Nodellum velascoensis* (Cushman), × 40. Figures 15, 16, much distorted. Figure 17, more normal form. Figures 15, 17, megalospheric. Figure 16, microspheric.

Plate 2

Figure 1. *Ammodiscus glabratus* Cushman and Jarvis, × 35.
2, 3. *Ammodiscus pennyi* Cushman and Jarvis, × 35. Figure 2, side view of megalospheric form. Figure 3, vertical section of another specimen.
4, 5. *Ammodiscoides turbinatus* Cushman, × 30. Figure 4, adult specimen from dorsal side. Figures 5 *a*, *b*, young specimen: *a*, Dorsal side; *b*, ventral side, showing the conical stage in the young.
6, 7. *Glomospira gordialis* (Jones and Parker), × 40.
8–10. *Glomospira charoides* (Jones and Parker) var. *corona* Cushman and Jarvis, × 60.
11 *a*, *b*. *Lituotuba lituiformis* (H. B. Brady), × 35. *a*, *b*, opposite sides.
12. *Ammolagena clavata* (Jones and Parker), × 30. Megalospheric specimen attached to *Ammodiscus pennyi*.
13–15. *Haplophragmoides coronata* (H. B. Brady), × 30. Specimens more or less distorted, showing the peculiar forms assumed by this species.

Plate 3

Figure 1. *Haplophragmoides excavata* Cushman and Waters, × 80.
2 *a*, *b*. *Haplophragmoides eggeri* Cushman, × 30. *a*, Side view; *b*, peripheral view.
3. *Cribrostomoides trinitatensis* Cushman and Jarvis, ×60. Apertural view of holotype specimen.
4, 5. *Ammobaculites coprolithiforme* (Schwager), × 40. Side views of specimens showing different stages in development.
6 *a*, *b*. *Cyclammina elegans*, news species, × 25. *a*, Side view; *b*, peripheral view.
7 *a*, *b*. *Spiroplectammina dentata* (Alth), × 30. *a*, Front view; *b*, apertural view.

FIGURES 8, *a*, *b*. *Spiroplectammina anceps* (Reuss) var., × 40. *a*, Front view; b. apertural view.

9, 10. *Spiroplectammina excolata* (Cushman). Figure 9, × 60; front view of partially developed specimen. Figure 10, × 40; very highly developed specimen. *a*, Front view; *b*, apertural view.

PLATE 4

FIGURES 1, 2. *Textularia concinna* Reuss. Figure 1, × 40. Figures 2 *a*, *b*, × 30. *a*, Front view; *b*, apertural view.

3 *a*, *b*. *Verneuilina polystropha* (Reuss), × 60. *a*, Front view; *b*, apertural view.

4 *a*, *b*. *Tritaxia pyramidata* Reuss, × 25. *a*, Front view; *b*, apertural view.

5. *Gaudryina filiformis* Berthelin, × 80.

6 *a*, *b*. *Gaudryina rugosa* d'Orbigny, × 30. *a*, Front view; *b*, apertural view.

7–10. *Gaudryina retusa* Cushman, × 40. Figure 8 *a*, Front view; *b*, apertural view. Figure 10, early Verneuiline stage.

11. *Gaudryina indentata* Cushman and Jarvis, × 35. Holotype.

PLATE 5

FIGURES 1, 2. *Gaudryina oxycona* Reuss. Figure 1, × 40. Figure 2, × 35. *a*, *a*, Front views; *b*, *b*, apertural views.

3. *Gaudryina laevigata* Franke var. *pyramidata* Cushman, × 35.

4. *Clavulina aspera* Cushman, × 30.

5. *Clavulina trilatera* Cushman, × 30.

6–8. *Clavulina aspera* Cushman, *whitei*, new variety, × 30. Figure 6, holotype; *a*, side view; *b*, apertural view. Figures 7, 8, microspheric specimens with angular later portions; *a*, *a*, side views; *b*, *b*, apertural views.

9–11. *Clavulina chitinosa*, new species, × 40. Figure 9, holotype. All specimens somewhat distorted by pressure.

PLATE 6

FIGURES 1 *a*, *b*. *Rzehakina epigona* (Rzehak) var. *lata* Cushman and Jarvis, × 30. *a*, Side view; *b*, apertural view.

2–5. *Trochammina globigeriniformis* (Parker and Jones), × 30. Figure 2 *a*, dorsal view; *b*, side view. Figure 3, side view. Figure 4, ventral view of a much distorted and compressed specimen. Figure 5, dorsal view.

6 *a–c*. *Trochammina trinitatensis* Cushman and Jarvis, × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

7 *a*, *b*. *Robulus williamsoni* (Reuss), × 40. *a*, Side view; *b*, apertural view.

8, 9. *Robulus oligostegia* (Ruess), × 40. Figure 9 *a*, side view; *b*, apertural view.

10 *a*, *b*. *Robulus trinitatensis*, new species, × 55. *a*, Side view; *b*, apertural view.

11 *a*, *b*. *Robulus sternalis* (Berthelin), × 40. *a*, Side view; *b*, apertural view.

PLATE 7

FIGURES 1, 2. *Robulus subalatus* (Reuss), × 35. Figure 2 *a*, side view; *b*, apertural view.
3 *a*, *b*. *Robulus macrodiscus* (Reuss), × 40. *a*, Side view; *b*, apertural view.
4 *a*, *b*. *Robulus discrepans* (Reuss), × 40. *a*, Side view; *b*, apertural view.
5 *a*, *b*. *Lenticulina navicula* (d'Orbigny), × 40. *a*, Side view; *b*, apertural view.
6 *a*, *b*. *Lenticulina nuda* (Reuss), × 60. *a*, Side view; *b*, apertural view.
7 *a*, *b*. *Marginulina grata* (Reuss), × 60. *a*, Side view; *b*, peripheral view.

PLATE 8

FIGURES 1, 2. *Planularia advena*, new species, × 15. Figure 1, holotype; *a*, side view; *b*, apertural view.
3 *a*, *b*. *Marginulina grata* (Reuss), × 40. *a*, Side view; *b*, peripheral view.
4 *a*, *b*. *Marginulina multiseptata* (Reuss), × 40. *a*, Side view; *b*, peripheral view.
5 *a*, *b*. *Marginulina schloenbachi* (Reuss), × 40. *a*, Side view; *b*, peripheral view.
6 *a*, *b*. *Marginulina modesta* Reuss, × 25. *a*, Side view; *b*, peripheral view.
7, 8. *Marginulina bullata* Reuss. Figure 7, × 40. Figure 8, × 60. Figure 7 *a*, side view; *b*, apertural view.
9. *Marginulina humilis* (Reuss), × 30.

PLATE 9

FIGURES 1 *a*, *b*. *Marginulina jonesi* Reuss, × 40. *a*, Side view; *b*, peripheral view.
2 *a*, *b*. *Marginulina decorata* (Reuss), × 25. *a*, Side view; *b*, peripheral view.
3, 4. *Marginulina trilobata* d'Orbigny. Figure 3, × 25. Figure 4, × 20. Figure 3 *a*, side view; *b*, peripheral view. Figure 4 *a*, side view; *b*, peripheral view.
5. *Dentalina megapolitana* Reuss, × 20.
6, 7. *Dentalina filiformis* Reuss (?), × 20. Figure 6, later chambers. Figure 7, earlier chambers including the proloculum.
8 *a*, *b*. *Dentalina catenula* Reuss, × 60. *a*, Side view; *b*, apertural view.
9. *Dentalina legumen* (Reuss), × 40.
10–12. *Dentalina confluens* Reuss, × 20.
13. *Dentalina* sp.(?), × 20.

PLATE 10

FIGURE 1. *Dentalina annulata* (Reuss), × 60.
2. *Dentalina lorneiana* d'Orbigny, × 30.
3. *Dentalina* sp.(?), × 25.
4. *Nodosaria concinna* Reuss, × 40.

FIGURE 5. *Nodosaria limbata* d'Orbigny, × 60.
6 *a*, *b*. *Nodosaria limbata* d'Orbigny *tumidata*, new variety, × 20. *a*, Side view; *b*, apertural view.
7, 8. *Nodosaria limbata* d'Orbigny *basiornata*, new variety, × 20. Figure 8, holotype.
9. *Nodosaria monile* v. Hagenow, × 20.
10. *Nodosaria orthopleura* Reuss, × 20.
11. *Nodosaria brevitesta* Franke, × 60.
12. *Nodosaria* cf. *marcki* Reuss, × 60.
13. *Nodosaria affinis* Reuss, × 20.
14, 15. *Nodosaria paupercula* Reuss, × 20.

PLATE 11

FIGURES 1–4. *Nodosaria velascoensis* Cushman. Figures 1, 2, × 60. Figures 3, 4, × 30. Figures 1, 2, portions possibly of the same specimen.
5. *Nodosaria aspera* Reuss, × 30.
6. *Nodosaria* sp. (?), × 20.
7, 8. *Pseudoglandulina cylindracea* (Reuss). Figure 7, × 30. Figure 8, × 20.
9. *Pseudoglandulina parallela* (Marsson), × 40.
10–12. *Pseudoglandulina bistegia* (Olszewski) (?). Figures 10, 11, × 25. Figure 12, × 40. Figure 10 *a*, side view; *b*, apertural view. Figures 10 and 11 are of a peculiar form in which the proloculum is peculiarly rugose.
13. *Pseudoglandulina* sp. (?), × 40.
14. *Flabellina semireticulata* Cushman and Jarvis, × 50.
15. *Flabellina reticulata* Reuss, × 50.

PLATE 12

FIGURE 1. *Flabellina interpunctata* von der Marck, × 40.
2. *Flabellina elliptica* (Nilsson), × 15.
3. *Frondicularia elongata* White (?), × 40.
4. *Frondicularia cordai* Reuss, × 30. Apertural half of a broken specimen.
5. *Frondicularia gracilis* Franke (?), × 20. Apertural half of a broken specimen.
6. *Lagena orbignyana* (Seguenza), × 40.
7 *a*, *b*. *Lagena orbignyana* (Seguenza) var., × 40. *a*, Side view; *b*, apertural view.
8 *a*, *b*. *Guttulina adhaerens* (Olszewski), × 40. *a*, Side view, *b*, apertural view.
9 *a*, *b*. *Pseudopolymorphina ozawana*, new species, × 20. *a*, Front view; *b*, apertural view.
10, 11. *Ramulina* sp. (?), × 30
12 *a*, *b*. *Nonion cretaceum*, new species, × 40. *a*, Side view; *b*, peripheral view.
13 *a*, *b*. *Operculina catenula*, new species, × 25. *a*, Side view; *b*, peripheral view.

PLATE 13

FIGURES 1 *a, b. Gümbelina* sp. (?), × 40. *a*, Front view; *b*, side view.
2. *Bolivinoides decorata* (Jones) var. *delicatula* Cushman, × 75.
3 *a, b. Bolivinoides trinitatensis* Cushman and Jarvis, × 75. *a*, Front view; *b*, apertural view.
4 *a, b. Bulimina trinitatensis* Cushman and Jarvis, × 75. *a*, Front view; *b*, apertural view.
5, 6. *Spiroplectoides clotho* (Grzybowski), × 75. Figure 5, microspheric form. Figure 6, megalospheric form.
7. *Lowostomum plaitum* (Carsey), × 55.
8 *a, b. Pleurostomella clavata* Cushman, × 40. *a*, Front view; *b*, apertural view.
9, 10. *Ellipsopleurostomella curta* Cushman, × 40. Figure 10 *a*, side view; *b*, apertural view.
11–13. *Ellipsonodosaria subnodosa* (Guppy). Figure 11, × 20. Figures 12, 13, × 40. Figures 11, 13, microspheric forms. Figure 12, megalospheric form.
14–16. *Ellipsoglandulina exponens* (H. B. Brady), × 50. *a*, *a*, Side views; *b*, *b*, apertural views.
17 *a–c. Valvulineria allomorphinoides* (Reuss), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

PLATE 14

FIGURES 1 *a–c. Gyroidina depressa* (Alth), × 55. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
2 *a–c. Gyroidina nitida* (Reuss), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
3, 4. *Gyroidina globosa* (v. Hagenow). Figure 3, × 55. Figure 4, × 40. *a*, *a*, Dorsal views; *b*, *b*, ventral views; *c*, *c*, peripheral views.
5 *a–c. Eponides haidingerii* (d'Orbigny), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
6 *a–c. Pulvinulinella velascoensis* (Cushman), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

PLATE 15

FIGURES 1, 2. *Pulvinulinella alata* (Marsson), × 40. Figure 1 *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
3 *a–c. Allomorphina trochoides* (Reuss), × 75. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
4 *a, b. Pullenia quinqueloba* (Reuss), × 40. *a*, Side view; *b*, apertural view.
5 *a, b. Pullenia coryelli* White, × 40. *a*. Side view; *b*, apertural view.
6 *a, b. Globigerinella* sp. (?), × 55. *a*, Side view; *b*, apertural view.
7 *a–c. Globotruncana arca* (Cushman), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.
8 *a–c. Globorotalia velascoensis* (Cushman), × 70. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

PLATE 16

FIGURES 1 *a–c*. *Anomalina ammonoides* (Reuss), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

2 *a–c*. *Anomalina polyrraphes* (Reuss), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

3–5. *Anomalina rubiginosa* Cushman, × 40. Figures 3, 4, young stages showing variation. Figure 5, adult. *a*, *a*, *a*, Dorsal views; *b*, *b*, *b*, ventral views; *c*, *c*, *c*, peripheral views.

6 *a–c*. *Planulina constricta* (v. Hagenow), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

7 *a–c*. *Planulina schloenbachi* (Reuss), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

8 *a–c*. *Planulina* sp. (?), × 40. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

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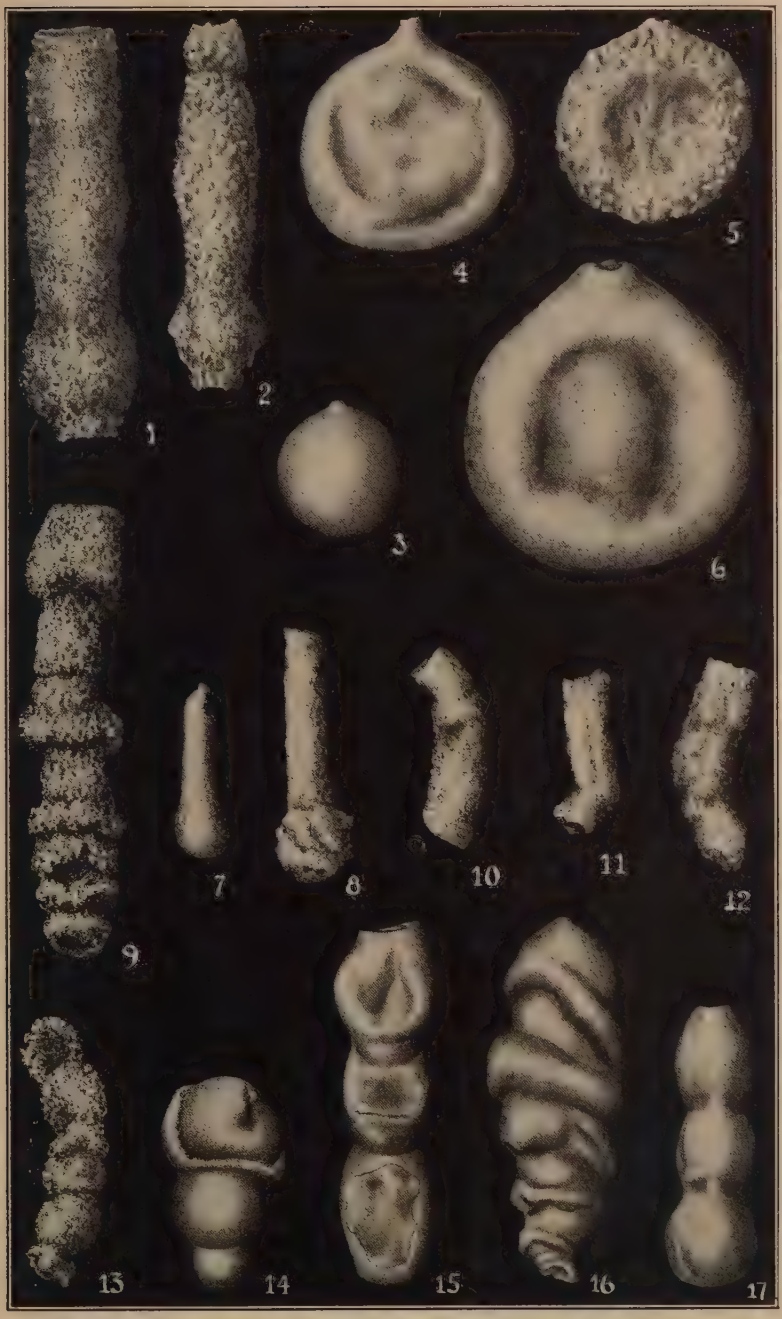

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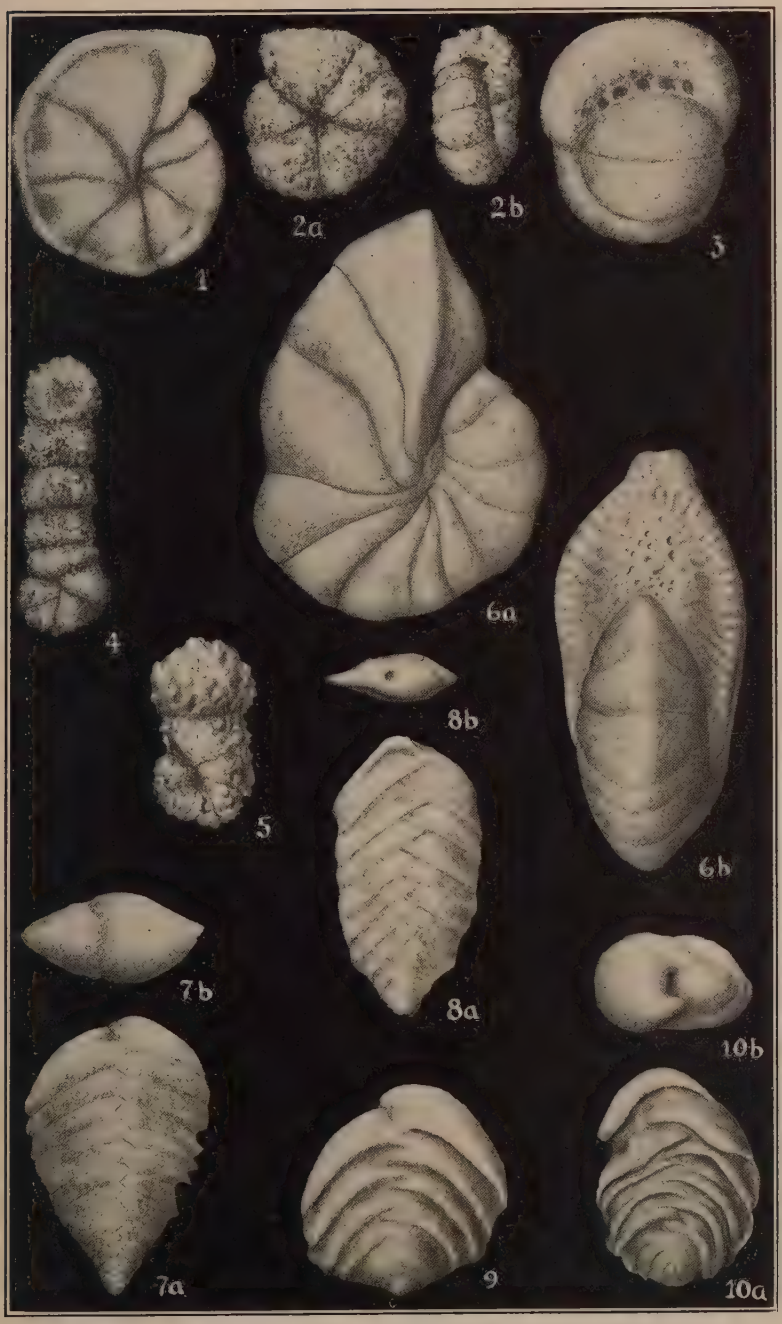

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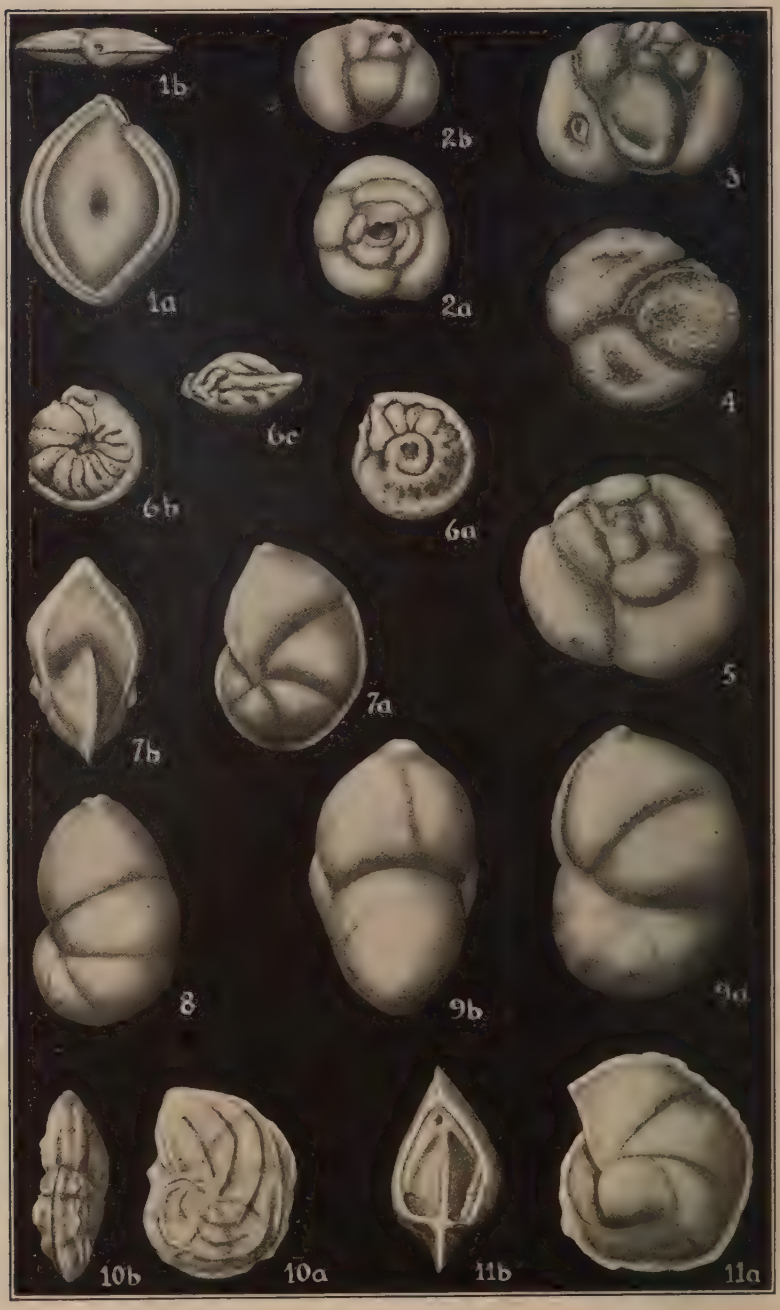

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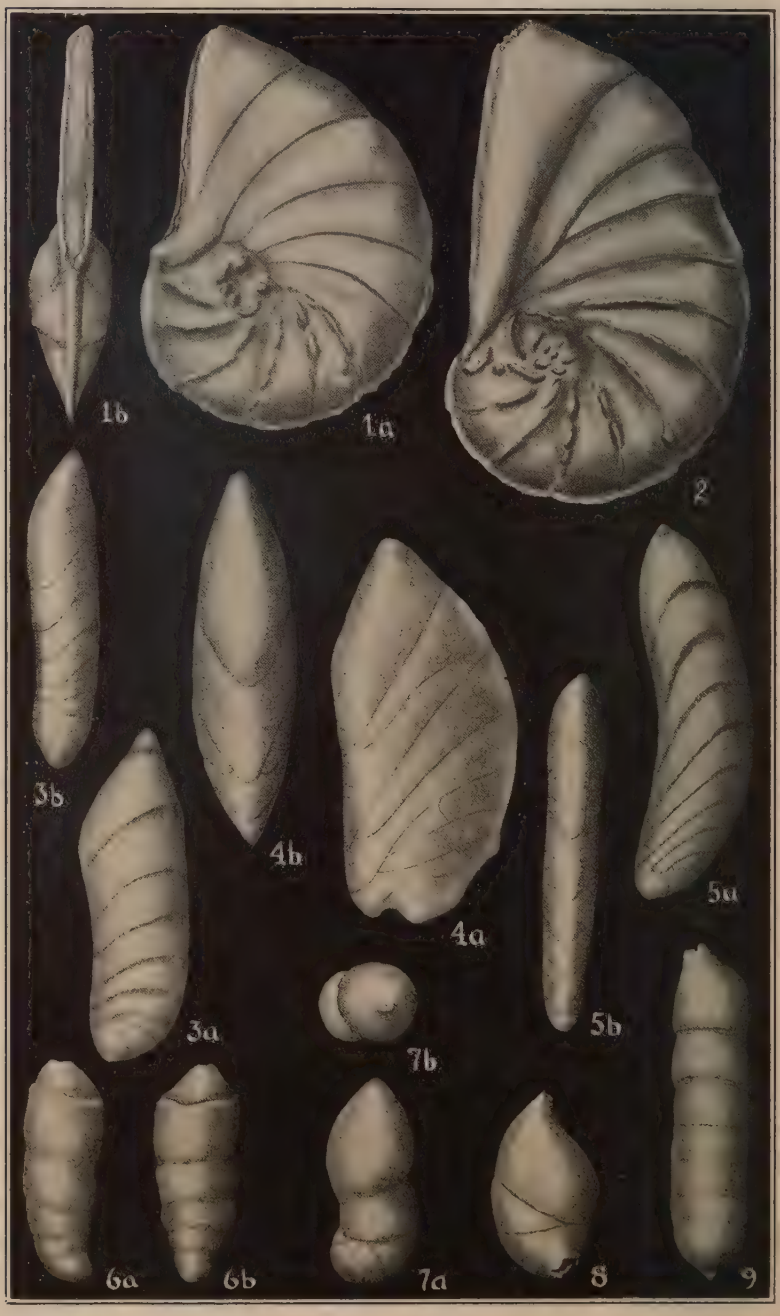

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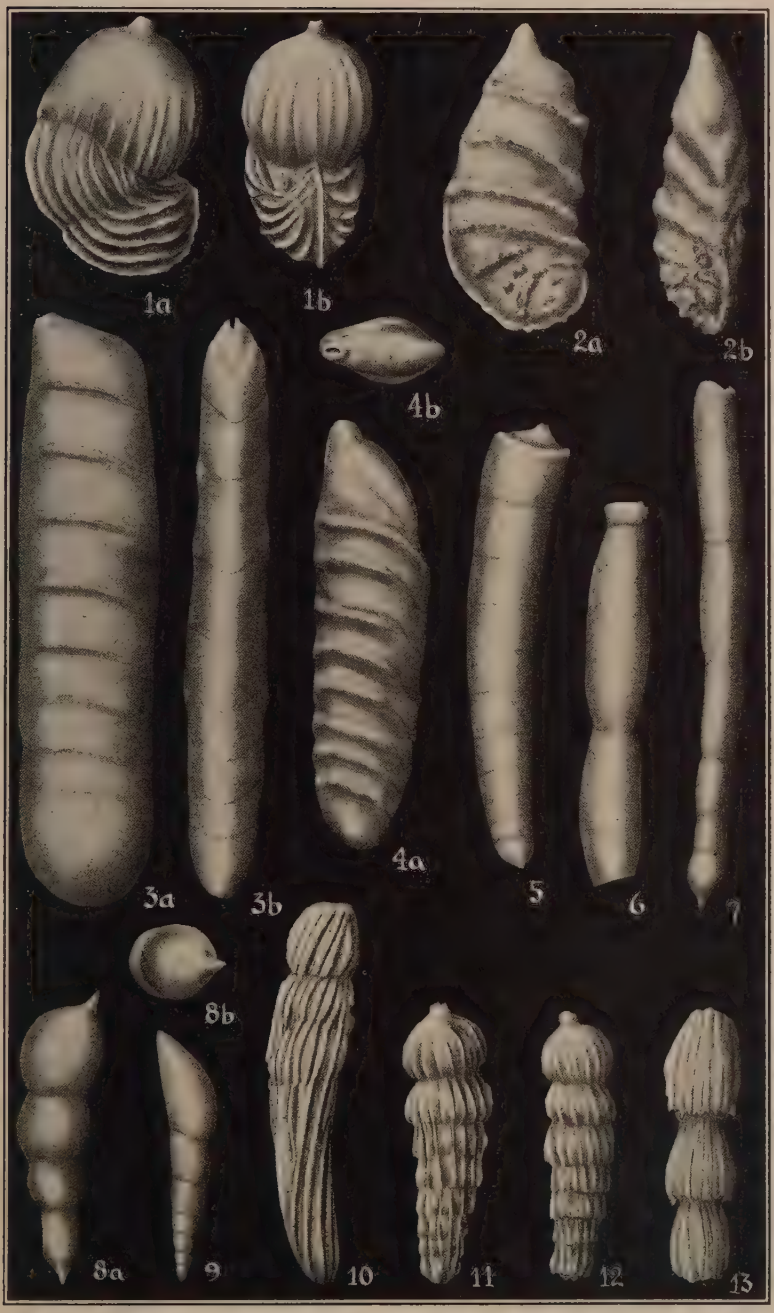

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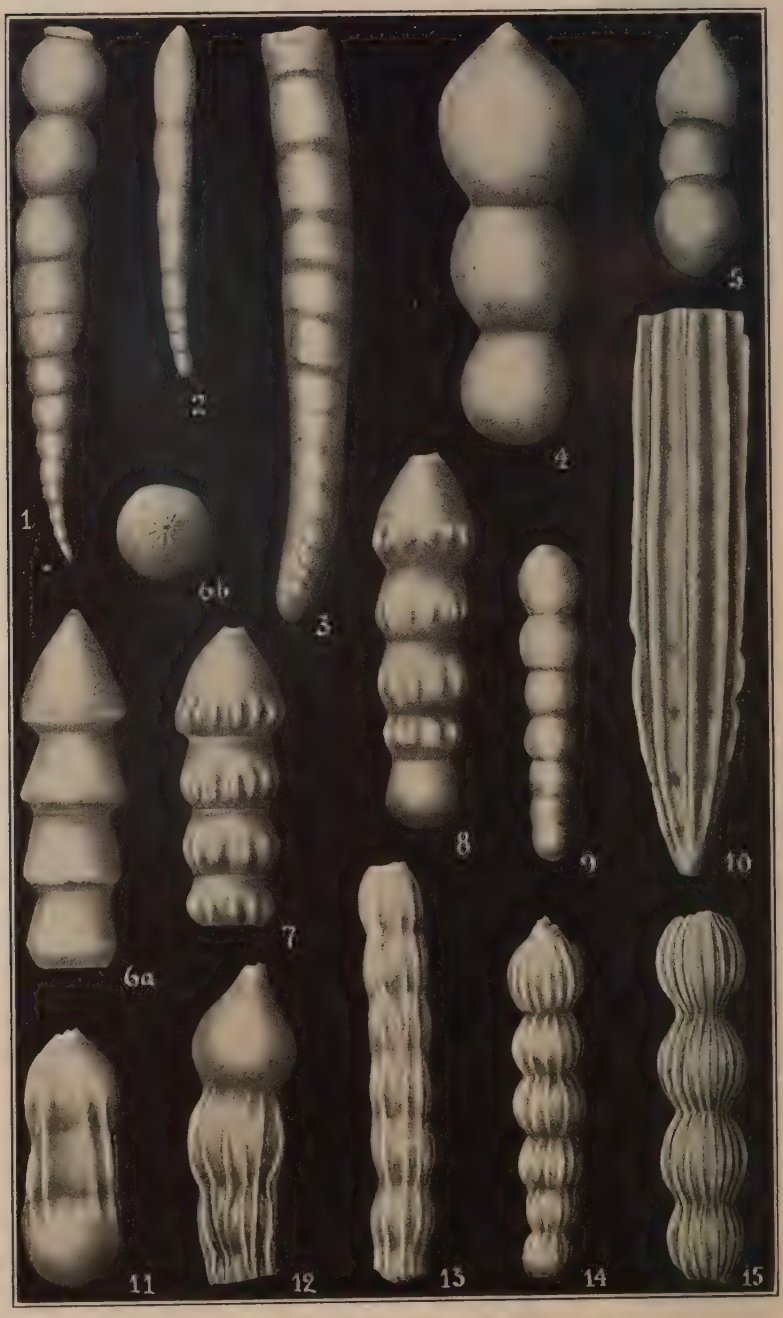

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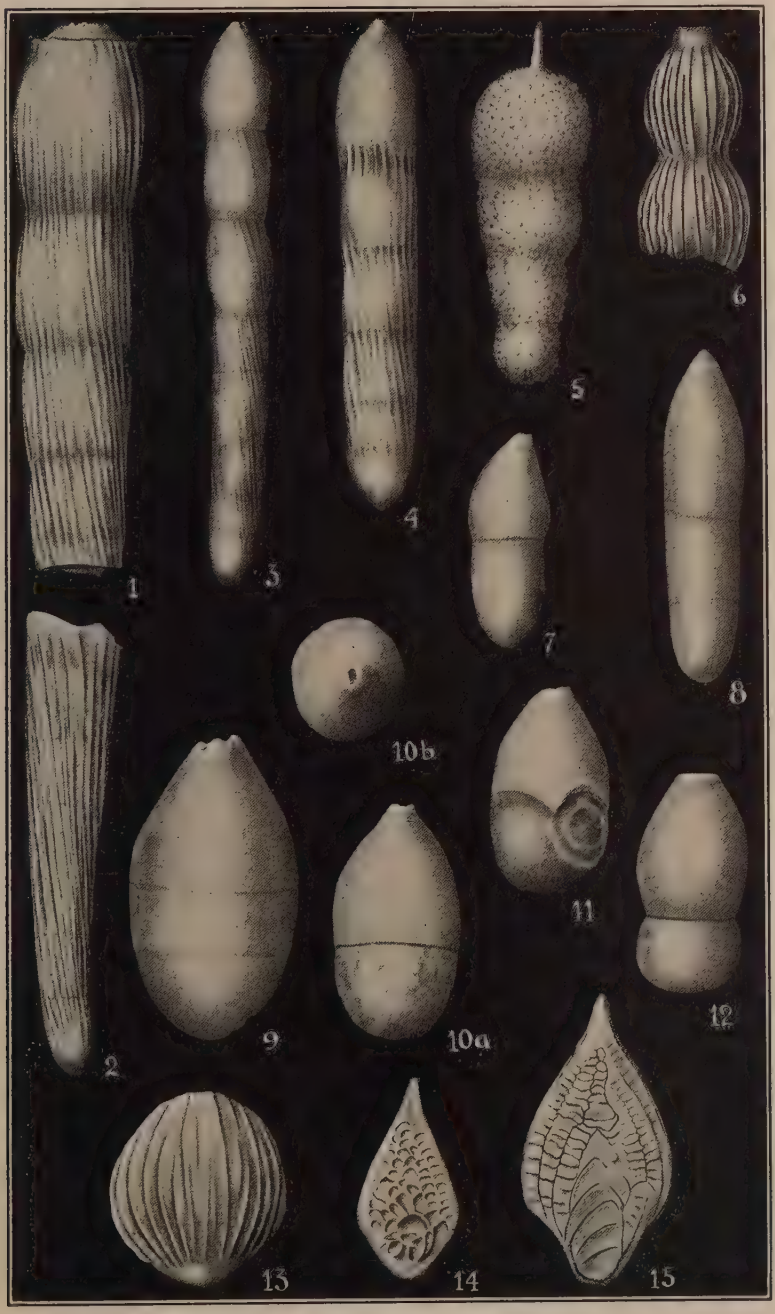

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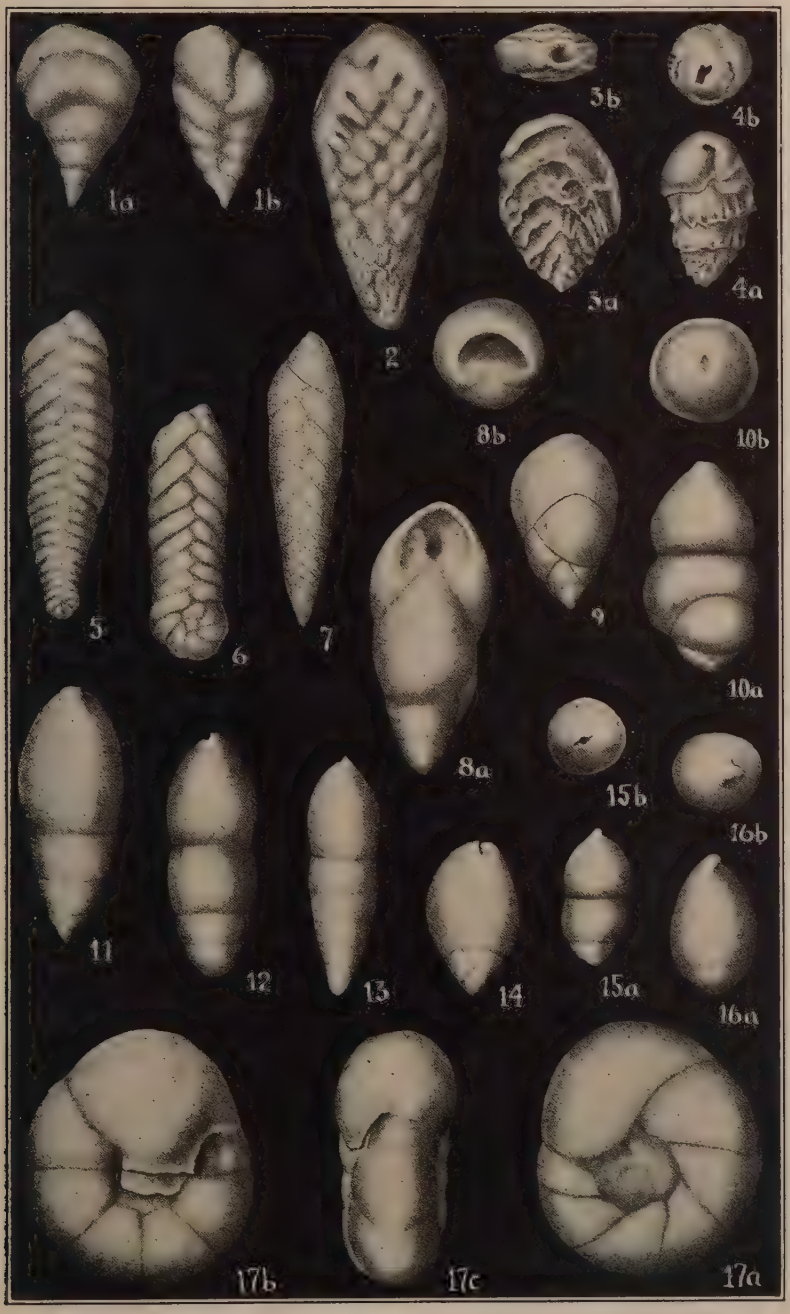

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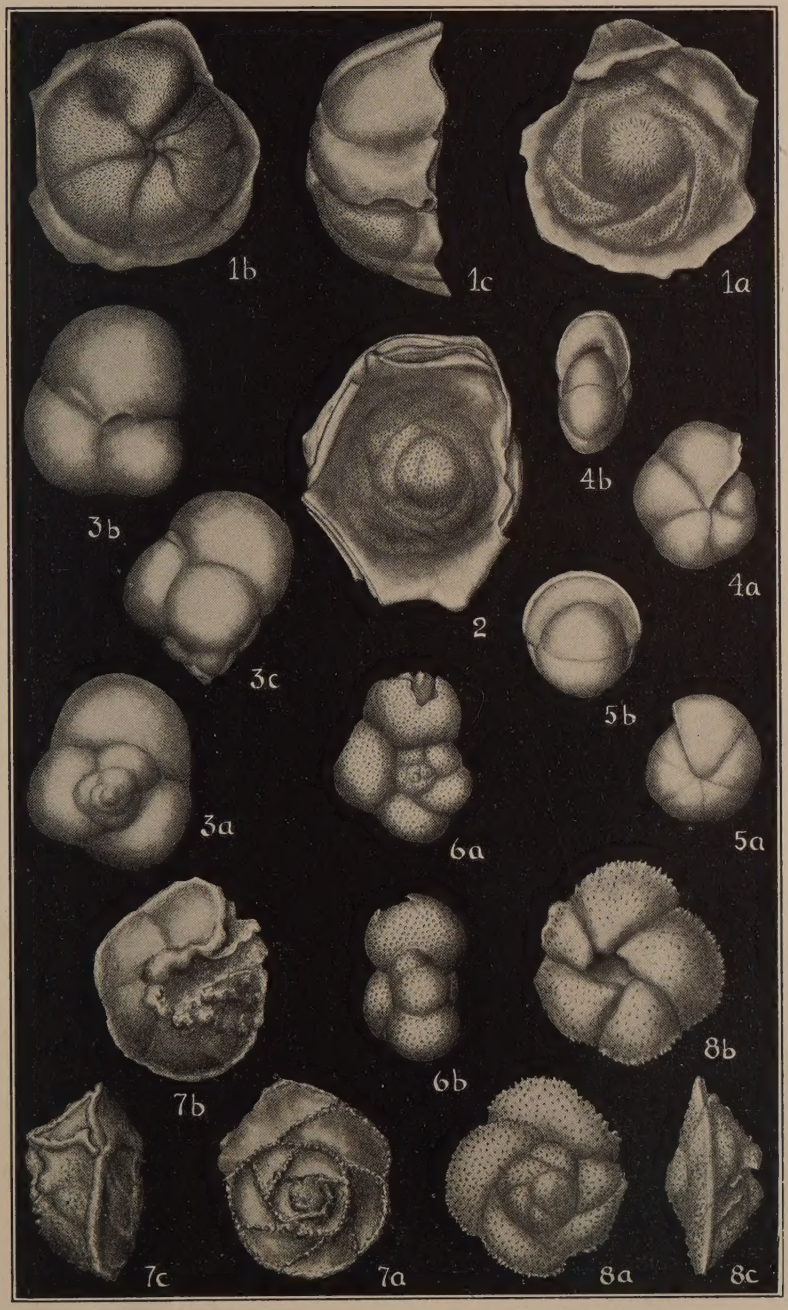

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